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INSPECTION OF COMMERCIAL FEED STUFFS

BY

P. H. SMITH and C. L. PERKINS.

This bulletin is published in accordance with the provisions of the Massachusetts feeding stuffs law. It contains a tabulation of the analyses of commercial feeding stuffs found offered for sale in the Massachusetts markets; presents a discussion of their relative values, calls attention to desirable and undesirable feeding stuffs for Massachusetts conditions and gives other information of interest to purchasers of commercial feeding stuffs. In addition will be found a tabulated list of the wholesale cost of feeding stuffs for the year 1910.

Requests for bulletins should be addressed to the
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AGRICULTURAL EXPERIMENT STATION,
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INSPECTION OF COMMERCIAL FEED STUFFS

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INTRODUCTION.

Requirements of Law.

The Massachusetts feeding stuffs law requires that all feeding stuffs sold or offered for sale in Massachusetts shall have affixed to each package in a conspicuous place the following information:

1. Name and address of the manufacturer or person responsible for placing the commodity on the market.
2. The net weight of the contents of the package.
3. The guaranteed minimum percentage of crude protein and of crude fat that the feeding stuff contains.
4. In case of admixtures the name of the foreign substance must be plainly printed upon each sack or parcel.
5. When feeding stuffs are stored in bulk and sold to order in purchasers' sacks, the foregoing information must be tacked up in a conspicuous place on or near the bin in which the material is stored.

The feeding stuffs exempted from the provisions of the act are hays and straws, the whole seeds and unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn, wheat bran, wheat middlings, wheat mixed feed. The above-mentioned grains when ground together and unmixed with other substances are also exempt.

Object of the Law.

The object of the law is, primarily, to protect the consumer from misrepresentation and fraud. It accomplishes this purpose by obliging the manufacturer to tell the truth about what he sells. The law is also of benefit to the honest manufacturer in that he is not obliged to enter into unequal competition with un-

scrupulous manufacturers of inferior adulterated products. The law has, indirectly, an educational value in that the enforcement of the statute stimulates a desire for knowledge in regard to feeding and the publication of the bulletins brings such information before the public.

Observance of the Law.

With few exceptions a spirit of co-operation between manufacturer, retailer and those having the enforcement of the law in charge is manifest. Occasional violations, possibly unavoidable but more often due to carelessness, are encountered. Retailers should always stipulate in contracts that "goods must conform to requirements of the Massachusetts law." During the past season a number of violations have been placed in an attorney's hands for settlement. In one instance proceedings were instituted against a dealer who had previously violated the law by offering for sale untagged goods. A plea of guilty was entered and the case placed on file. It is not the intention of the experiment station to be unreasonable in regard to the matter, but where persistent violations are encountered the only resource is to prosecute.

Needs of Law.

Massachusetts was the pioneer state in feed control inspection. The law as originally drafted simply provided for inspection and for the publication of results. Not anything was obligatory on the part of manufacturers, and inspectors were simply allowed access to places where feed stuffs were stored or offered for sale, with the privilege of taking samples. In 1902 the old law was repealed and the present law substituted. Profiting by the experience of the pioneer states other states have now enacted superior control laws. It is felt that the Massachusetts law should be revised and rewritten in the near future. Following are some of the essential features which should be incorporated.

1. *Revenue.* An increase of revenue for the more satisfactory execution of the law.

2. *Fiber.* In addition to the guaranteed minimum per cent of protein and fat the maximum fiber guarantee should be stated. Protein and fiber are a much better index for determining the value of a feeding stuff than protein and fat.

3. *A statement of the ingredients contained in mixed or compounded feeds.* The fiber guarantee and statement of ingredients are included in the requirements of all of the more recently enacted laws and, in fact, many feeding stuffs manufactured in other states and found on sale in Massachusetts have tags attached which give this information.

Definitions. At present there is more or less confusion in different states and in different sections of the country in regard to names of commercial by-products used for feeding. A feeding stuff which is recognized by one name in the west may be known by an entirely different name in the east. For example, the term provender throughout New England is quite generally taken to signify a mixture of pure corn and oats ground together, while in other sections of the country the term has no such significance. Again, manufacturers of low grade goods often attach names which are misleading or at best have no definite meaning. For example, the term flax bran is used, although the material so named is not a bran at all but the ground refuse, (stalks and pods) of the flax plant. The National Association of Feed Control Officials is considering the matter of uniform definitions for the different commercial feeding stuffs. Such a group of definitions if adopted by the feed control officials of the different states will be of great benefit to the retailer and manufacturer.

Fiber. Fiber forms a large part of the framework of plants and the tough outer coating of seeds. In pure form it is known as cellulose. It is a useful component of feeding stuffs intended for farm animals in that it gives the necessary bulk to the ration and is found in an amply sufficient amount in home-grown coarse fodders. The value of a feeding stuff used as a supplement to home-grown feeds especially in dairy farming is measured largely in terms of protein and digestibility, home-grown coarse feeds being generally deficient in both protein and digestible matter. There is no ingredient present in feeding stuffs which so depresses digestibility as fiber. In purchasing concentrated feeds the feeder should look for high protein and low fiber, as a high fiber content is indicative of the addition of oat hulls, ground corn cob or other low grade material.

An important factor to be considered is that fiber derived from different sources has a different feeding value. Thus the fiber derived from the hull of the cottonseed, oat and barley and from corn cobs has a much lower digestibility and consequently nutritive value than that derived from the hull of corn or wheat.

Weight of Sacked Feeds. There is a growing tendency on the part of some manufacturers to state gross weight of a package instead of the weight of the contents. Others state both net and gross weights. *The state law calls for the weight of the contents of the package.* Purchasers who buy sacked feeds should see that they are getting full weight. The difference between gross and net weight will amount to about one pound per sack.

Work of the Year. During the past year J. T. Howard, the official inspector, has covered the state twice and has drawn 1055 samples of the various feeding stuffs offered for sale. These have been carefully examined and the results are herewith presented.

Classification. The classification of feeding stuffs used in this bulletin, with the exception of a few minor changes, has been in use since the publication of the first feeding stuffs bulletin and was the work of Dr. J. B. Lindsey. In the present publication it has been thought best, where the name of a subdivision was not entirely self-explanatory, to accompany it with a definition placed at the head of each analytical table.

STANDARDS FOR CATTLE AND POULTRY FOODS.

A standard for comparison is always necessary in passing judgment on the composition of concentrated feeds. The percentages of protein, fat and fiber **serve as an index** of their character in the majority of cases. To be of **standard quality,** the various concentrates should be free from foreign material, mould and rancidity, in good mechanical condition, and maintain the following percentages of protein, fat and fiber:—*

	Feed Stuff.	Protein.	Fat.	Fiber.
Protein Feeds.	Blood meal	85	0.2	—
	Cottonseed meal (choice)	41-46	8-10	7
	Cottonseed meal (prime, good)	36-41	7-9	8
	Cottonseed meal (low grade)	24	5-6	18
	N. P. linseed meal	38	2	9
	O. P. linseed meal	32	6	9
	Gluten feed	25	3	7.5
	Distillers' dried grains (corn)	31	10	12
	Malt sprouts	25	1	12.5
	Brewers' dried grains	22	5	12
	Wheat middlings (flour)	18-20	5	3.5
	Wheat middlings (standard)	17-19	5	7
	Wheat mixed feed	16-18	4.5	8.5
	Wheat bran	15-17	4.5	10
	Oat middlings	17	7	2.5
	Rye feed	15	3	4
Starchy (Carbohydrate) Feeds.	Ground oats	11	4	10
	Ground wheat	11	2	3
	Barley meal	11	1.5	6
	Rye meal	10	1.5	2
	Corn meal	8.5	3	2
	Hominy meal	10	7.5	4.5
	Provender	10	3.5	6
	Corn and oat feed	8-10	3-5	—
	Fortified oat feed	12-14	3-5	—
	Oat feed	5-8	2	20-26
	Corn bran	9	5	10
	Dried beet-pulp	8	0.3	18
Poultry Feeds.	Meat scraps	50	15	
	Meat and bone meal	40	10	
	Bone meal	25	...	...
	Poultry mash and meal	15	4-5	
	Chick and scratching grains	10	3	
	Alfalfa meal, entire plant	14	1.5	25
	Clover meal, entire plant	12	2	25

*Fiber is the least valuable of the several constituents; the above standards for fiber represent the maximum percentage which the feed should contain to be of standard quality.

CHEMICAL ANALYSES OF FEED STUFFS.

1910 *Collection.*

I. Protein Feeds.

COTTONSEED MEAL.

Definitions.*COTTONSEED MEAL is the ground residue obtained in the extraction of oil from the cottonseed kernel.
CHOICE cottonseed meal contains at least 41 per cent protein.
PRIME cottonseed meal contains at least 38.5 per cent protein.
GOOD cottonseed meal contains at least 36 per cent protein.
COTTONSEED FEED is a mixture of cottonseed meal and cottonseed hulls containing less than 36 per cent protein.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Fiber.
			Found.	Guar.	Found.	Guar.	
Choice.							
American Cotton Oil Co., New York.							
	F. E. Smith	Amherst	40.85	41.00	8.93	9.00	—
	W. Lord	Athol	42.73	41.00	6.92	9.00	—
F. W. Brode & Co., Memphis.							
Owl,	F. E. Smith	Amherst	41.07	41.00	7.58	6.00	—
Owl,	Bryant & Soule	Middleboro	47.30	41.00	7.88	6.00	—
Owl,	Goding Bros.	N. Easton	41.31	41.00	7.40	6.00	—
Dove,	J. W. Doon & Son	Natick	41.56	38.00	7.35	7.00	—
Dove,	Worcester Hay&Grain Co.	Worcester	42.07	38.00	7.24	7.00	—
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
Buckeye,	F. H. Whitaker	E. Longmeadow	40.85	39.00	7.51	6.50	—
Buckeye,	G. Methe & Son	Springfield	41.24	39.00	7.50	6.50	—
S. P. Davis, Little Rock, Ark.							
Good Luck,	Fosketts Mills	Brimfield	41.24	41.00	7.46	7.00	—
Good Luck,	A. H. Wood & Co.	Framingham	46.64	38.00	8.93	9.00	—
J. B. Garland & Son, Worcester.							
Golden Eagle,	F. Diehl & Son	Wellesley	42.56	41.00	8.20	9.00	—
Golden Eagle,	J. B. Garland & Son	Worcester	42.16	41.00	8.51	9.00	—
Humphreys, Godwin & Co., Memphis.							
Dixie,	E. C. Frost	Shelburne Falls	43.17	38.50	7.66	7.00	—
Dixie,	Taunton Teaming Co.	Taunton	42.29	38.50	9.63	7.00	—
Imperial Cotton Milling Co., Memphis.							
	J. F. Shine	Dedham	40.76	41.00	9.99	9.00	—
	Hobart Mills	E. Braintree	45.06	41.00	7.33	9.00	—
	Lamb Bros. & Co.	Orange	43.61	41.00	7.62	9.00	—
	J. Paull & Co.	Taunton	41.07	41.00	8.23	9.00	—
McCaw Manufacturing Co., Hurtsboro, Ala.							
Prime,	J. W. Doon & Son	Natick	40.76	39.00	6.83	9.00	—
Prime,	Springfield Flour&Gr. Co.	Springfield	42.59	39.00	8.26	9.00	—
J. E. Soper Co., Boston.							
Choice bolted,	Bedford Coal & Grain Co.	Bedford	41.59	40.00	8.61	7.00	
Prime,	Knight Grain Co.	Newburyport	41.64	38.50	7.41	5.00	
	Highest		47.30	—	9.99	—	—
	Lowest		40.76	—	6.83	—	—
	Average		42.35	—	7.96	—	—

*Definitions used in connection with these tables merely indicate our basis of classification. In so far as possible they are based on trade usage, and are subject to future change and revision.

COTTONSEED MEAL (Continued).

Manufacturer or Jobber, Brand	and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
Prime.							
American Cotton Oil Co., New York.							
*Choice,	C. T. Wyman	Hubbardston	40.10	41.00	7.27	9.00	
*Choice,	A. Culver Co.	Rockland	38.52	41.00	13.10	9.00	
*Choice,	J. O. Dean & Co.	S. Easton	38.74	41.00	7.83	9.00	
F. W. Brode & Co., Memphis.							
	Hingham Gr. Mill Co., Inc.	Hingham	40.14	41.00	7.59	7.00	
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
Prime,	W. Lord	Athol	40.24	39.00	7.60	6.50	
Prime,	S. P. Puffer	N. Amherst	39.05	39.00	6.30	6.50	
Prime,	Glen Mills Cereal Co.	Rowley	38.79	39.00	7.00	6.50	
Chapin & Co., Boston.							
*Green Diamond,	C. L. Beals & Co.	Winchendon	39.97	41.00	12.40	9.00	
De Soto Oil Co., Memphis.							
De Soto,	H. Houghton	Millbury	39.88	41.00	7.75	8.50	
De Soto,	W. F. Fletcher	Southwick	38.31	41.00	7.34	8.50	
Humphreys, Godwin & Co., Memphis.							
Dixie,	F. Knight	Charlton	38.91	38.50	8.35	7.00	
Dixie,	W. J. Meek	Fall River	40.72	38.50	9.34	7.00	
Dixie,	A. Culver Co.	Rockland	39.24	38.50	6.39	7.00	
	H. G. Hill Co.	Williamsburg	39.38	41.00	6.66	7.00	
Hunter Bros. Milling Co., St. Louis.							
Prime,	G. C. Turner	Chester	38.54	38.50	7.49	6.50	
Prime,	Hobart Mills	E. Braintree	39.36	41.00	8.38	7.50	
Prime,	O. F. Metcalf & Sons.	Franklin	40.32	38.50	6.71	6.50	
C. C. Johnson & Co., Memphis.							
Prime,	E. A. Cowee	Jefferson	39.27	41.00	7.31	8.00	
J. E. Soper Co., Boston.							
*Choice,	Prentiss, Brooks & Co.	Easthampton	39.14	41.00	9.38	8.00	
Blackstone Smith, New Orleans, La.							
Purity,	Taunton Grain Co.	Taunton	40.45	41.00	7.70	5.00	
J. Lindsay Wells Co., Memphis.							
*Red Star,	J. F. Ray	Franklin	38.31	41.00	8.32	9.00	
	Highest		40.72	—	13.10	—	
	Lowest		38.31	—	6.30	—	
	Average		39.45	—	8.06		
Good.							
American Cotton Oil Co., New York.							
*Choice,	Potter Grain Co.	Shelburne Falls	37.04	41.00	8.31	9.00	
Davisboro Cotton Oil & Grain Co., Davisboro, Ga.							
	Prentiss Brooks & Co.	Westfield	37.01	38.62	9.41	—	
Humphreys, Godwin & Co., Memphis.							
Dixie,	H. G. Hill Co.	Williamsburg	38.02	38.62	7.67	8.00	
J. E. Soper Co., Boston.							
**Prime,	Eastern Grain Co.	Bridgewater	37.86	38.50	7.07	5.00	
Cottonseed Feed.							
Florida Cotton Oil Co., Jacksonville, Fla.							
Durham,	Ropes Bros.	Danvers	23.30	25.75	6.87	—	17.71
Durham,	E. O. Parker	Stoughton	23.52	25.75	6.73	—	17.03
Humphreys, Godwin & Co., Memphis.							
77 Feed Meal,	J. B. Bridges & Co.	S. Deerfield	22.23	22.25	3.73	4.50	23.00

*Misbranded Choice

**Misbranded Prime.

LINSEED MEAL.

Definition. Linseed meal is the ground residue obtained in the extraction of oil from flaxseed.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
1. New Process.						
American Linseed Co., New York.						
Cleveland Flaxmeal, . . . Ropes Bros.	Salem	38.75	36 00	2.71	1.00	—
Cleveland Flaxmeal, . . C. B. Sawin & Son	Southboro.	38.70	36.00	2.26	1.00	—
Cleveland Flaxmeal, . . C. B. Sawin & Son	Southboro.	37.21	36.00	2.18	1 00	—
Dennison Plummer Co.	New Bedford	38.02	36.00	2.30	1.00	—
J. Paull & Co.	Taunton	37.12	36.00	3.07	1.00	—
Average		37.96	—	2 50	—	—
2. Old Process.						
American Linseed Co., New York.						
Cutler Co.	N. Wilbraham	37.12	32.00	5.38	5.00	—
A. J. Lane Co.	Springfield	37.17	32.00	5.47	5.00	—
Springfield Flour&Gr. Co.	Springfield	37.73	32.00	6.10	5.00	—
Bliss & Co.	Taunton	36.95	32 00	5.63	5.00	—
Chapin & Co, Buffalo, N. Y.						
S. R. Carter	W. Berlin	35 64	33.00	4.25	5.00	—
Mann Bros. Co., Buffalo, N. Y.						
Bedford Coal & Gr. Co.	Bedford.	37.71	34.00	6.58	6.00	—
Guy G. Major Co., Toledo, Ohio.						
C. Bond	Charlton	31.00	30.00	6.95	5.00	—
H. A. Crossman Co.	Needham	36.86	30.00	5.54	5.00	—
W. T. McLaughlin & Co.	W. Roxbury	29.26	30.00	7.37	5.00	—
Midland Linseed Co., Minneapolis, Minn.						
C. S. Barber	Bernardston	36.47	32 00	7.73	5.50	—
H. K. Webster Co.	Lawrence	34.59	32.00	6.69	5.50	—
A. Milot & Son	Taunton	37.34	32.00	7.58	5.50	—
C. G. Jordan	Weymouth	36.30	32.00	5.90	5.50	—
Metzger Seed & Oil Co., Toledo, Ohio.						
J. F. Ray	Franklin	33.81	30.00	6.89	5.00	—
Kelloggs & Miller, Amsterdam, N. Y.						
C. T. Wyman	Hubbardston	37.13	33.00	6.28	5.00	—
A. D. Potter	Orange	37.27	33.00	5.56	5.00	—
A. D. Potter	Orange	36.48	33.00	7.19	5.00	—
Average		35.96	—	6.10	—	—

GLUTEN FEED.

Definition. Gluten feed is a product obtained in the manufacture of starch and glucose from corn, and consists largely of the flinty portion of the kernel and corn bran.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber.
American Maize Products Co., New York.						
Cream of Corn, . Thatcher & Ireland	Littleton	27.11	23.00	6.15	2.50	—
Cream of Corn, . C. P. Washburn	Middleboro	26.67	23.00	2.20	2.50	—
Cream of Corn, . A. Carr	Northboro	23 96	23.00	2.44	2.50	—
Cream of Corn, . W. P. Barney	Seekonk	26 44	23.00	2.38	2.50	5.90
Cream of Corn, . . F. Diehl & Son	Wellesley	25.36	23 00	3.05	2.50	—
B. W. Brown	Concord	24.37	23 00	4.19	2.50	6.68
B. W. Brown	Concord	23.95	23.06	3.54	2.50	5.99
Ropes Bros.	Danvers	23 65	23.00	3.55	2.50	6.66
J. Shea	Lawrence	23 78	23.00	2.78	2.50	5.50
J. Shea	Lawrence	26 39	25.00	2.92	2.50	—
Average		25.22	—	3.32	—	6.15
Corn Products Refining Co., New York.						
Buffalo, . Bedford Coal & Grain Co.	Bedford	23.64	23 00	4.18	2.50	6.30
Buffalo, . J. O. Ellison & Co.	Haverhill	28.33	24.00	1.98	2.50	6.00
Buffalo, . J. O. Ellison & Co.	Haverhill	28.02	24.00	2.05	2.50	6.50
Buffalo, . C. T. Wyman	Hubbardston	25 43	24.00	3.74	2.50	6.04
Buffalo, . Conant & Co.	Littleton	27.27	23.00	2.70	2.50	—
Buffalo, . M. G. Williams	Raynham	27.63	24 00	2.53	2.50	4.11
Buffalo, . C. O. Parmenter & Co.	S. Sudbury	24 30	23.00	3.57	2.50	5.98
Buffalo, . . Bliss & Co.	Taunton	23.39	24 00	3.52	2.50	—
Average		26.00	—	3.03	—	6.19

GLUTEN FEED —(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at.	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber
Corn Products Refining Co., (Cont.).							
Crescent,	A. H. Wood & Co.	Framingham	23 34	24 00	2 00	2 50	7 00
Crescent,	Hathaway & Mackenzie	New Bedford	24.10	24 00	4 40	2 50	0 04
Globe,	F. G. Cover & Co.	Lowell	23 02	24 00	2 00	2 50	7 20
Globe,	J. W. Doon & Sons	Natick	26 50	24 00	2 07	2 50	
Globe,	Potter Grain Co.	Shelburne Falls	25 09	24 00	2 85	2 50	0 40
Pekin,	D. H. Craig	Plymouth	20 55	23 00	1 77	2 50	
Curley Bros., Wakefield.							
Boston,	Curley Bros.	Wakefield	24 33	24 00	3.30	3 00	0 10
J. C. Hubinger Bros. Co., Keokuk, Iowa.							
K. K. K.	H. Houghton	Millbury	24.39	23 00	2.46	2 00	
K. K. K.	J. Paull & Co.	Taunton	24.18	23.00	2 23	2 00	
K. K. K.	P. W. Eaton & Co.	Williamstown	23.85	23 00	4 20	2.00	
Huron Milling Co., Harbor Beach, Mich.							
Jenks,	J. Burkhardt	Beverly	22 68	23.00	2 69	3 00	
Jenks,	Loham Bros.	Marblehead	24 57	23.00	3 55	3 00	0 33
Narragansett Milling Co., E. Providence.							
	R. M. Reed	N. Westport	23.34	20 00	3 57	2 50	-
Union Starch & Refining Co., Edinburg, Ind.							
Union,	W. H. Cunningham & Son	Malden	24.66	24.00	4 15	3 00	—
	Highest		23 34	—	6 15	—	7 35
	Lowest		22 63	—	1 77	—	4 11
	Average		25 22	—	3 17	—	5 92
Second Grade (below 23 per cent protein).							
Clinton Sugar Refining Co., Clinton, Iowa.							
Clinton,	A. M. Butler	Avon	21.16	20 00	5.64	3.00	5 93
Clinton,	W. C. S. Wood	Norton	22 33	20 00	3 69	3.00	-
Meech & Stoddard, Middletown, Conn.							
	J. A. Bouvier	New Bedford	18.70	22 00	3 59	4.00	6.47
J. E. Soper Co., Boston.							
Bay State,	Marlboro Grain Co.	Marlboro	20.67	22 00	6.51	4 00	—
Bay State,	Cole Bros.	Swansea	21.64	22.00	6.30	4 00	—
Globe Elevator Co., Buffalo, N. Y.							
Royal,	M. H. Rolfe Est.	Newburyport	20.97	20 00	4 76	2 00	10.19
	Average		20.91	—	6 00	—	7 53

DISTILLERS' DRIED GRAINS.

Definition. Distillers' dried grains are the dried residue obtained from cereals in the manufacture of alcohol and distilled liquors.

Manufacturer or Jobber, Brand and Retailer.		Sampled at.	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber
Ajax Milling & Feed Co., Buffalo, N. Y.							
Ajax Flakes,	Eastern Grain Co.	Bridgewater	23 48	31 00	12 00	12 11	14.12
Ajax Flakes,	Robinson & Jones Co.	Natick	31.00	31 00	12.34	12 00	11 97
Ajax Flakes,	Morse Bros.	Southbridge	20.55	30 33	12 05	11.00	12 62
Ajax Flakes,	H. W. Hill & Co.	Williamsburg	31.81	31 00	12.51	12 00	12 02
	Average		30 23		12 25	-	12 01
J. W. Biles Co., Cincinnati, Ohio.							
Dearborn,	J. Shea	Lawrence	23 05	22 00	7 34	3 00	11 00
Dearborn,	A. Carr	Northboro	22 34	22 00	8 70	3 00	12 11
Fourex,	Mackenzie & Winslow	Fall River	31.02	31 00	11.70	12 00	12 37
Fourex,	Bryant & Soule	Middleboro	32 47	31 00	10 01	12.00	11 00
Fourex,	J. W. Doon & Son	Natick	31 40	31 00	12 40	12 00	12 02
Fourex,	Potter Bros. & Co.	N. Adams	31 24	31 00	10 40	12 00	12 50
Fourex,	Cutler Grain Co.	S. Framingham	31.00	31 00	11 47	12 00	12 40

DISTILLERS' DRIED GRAINS—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Fiber.
			Found.	Guar.	Found.	Guar.	
Continental Cereal Co., Peoria, Ill.							
Continental, . .	Potter Grain Co. .	Shelburne Falls . .	30.65	31.00	12.31	13.50	7.65
Continental, .	Potter Grain Co.	Shelburne Falls . .	28.85	31.00	10.97	13.50	8.64
Dewey Bros. Co., Blanchester, Ohio.							
Dewey's, .	J. Shea . .	Lawrence	30.91	30.00	10.76	12.00	12.03
Hottelet Co., Milwaukee, Wis.							
Rye Grains, .	J. Burkhardt . .	Beverly .	*14.09	16.00	*6.34	8.00	15.03
Rye Grains,	Lexington Grain Co. .	Lexington	*13.20	16.00	*5.94	8.00	16.03
	Average . . .	. . . . . .	29.67	—	11.16	—	12.24

*Not included in average.

MALT SPROUTS.

Definition. Malt sprouts consist of the dried sprouts of the barley grain removed after the process of malting.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber.
American Malting Co., Syracuse, N. Y.							
	Ropes Bros.	Danvers .	28.22	25.00	1.03	3.00	13.86
	J. B. Garland & Son . .	Worcester	31.17	21.17	1.01	1.96	13.08
Atlantic Export Co., Chicago, Ill.							
	S. B. Boutelle & Sons . .	Shrewsbury	26.62	25.00	1.19	1.50	10.92
	E. A. Cowee	Jefferson . .	25.96	25.00	.89	1.50	11.95
Geo. J. Mayer Malting Co., Buffalo, N. Y.							
	B. W. Brown .	Concord .	24.34	20.82	.91	1.15	14.02
Perot Malting Co., Buffalo, N. Y.							
	C. O. Parmenter & Co.	S. Sudbury	27.56	25.00	.79	1.10	11.51
M. G. Rankin & Co., Milwaukee, Wis.							
Jersey, . .	J. W. Doon & Son .	Natick.	25.80	25.00	1.28	2.00	12.81
D. W. Ranlet Co., Boston, Mass.							
	Ropes Bros. .	Salem .	24.08	23.00	.97	1.50	12.34
	Average	. . . . . .	26.72	—	1.01	—	12.56

BREWERS' DRIED GRAINS.

Definition. Brewers' dried grains are the dried residue obtained from cereals in the manufacture of malted liquors.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber.
Atlantic Export Co., Chicago, Ill.							
	H. A. Crossman Co.	Needham .	33.08	27.00	6.54	7.00	12.41
M. F. Baringer, Philadelphia, Penna.							
	Torrence Vary & Co.	Lynn .	27.61	25.00	7.08	6.00	13.48

WHEAT MIDDLINGS.

Definition. Wheat middlings consist of the finer portions of bran, the germ and more or less flour obtained from the wheat kernel in the milling of wheat. Standard middlings contain the smallest proportion of flour, flour middlings considerably more, while red dog is a flour middlings in which the flour predominates.*

No. Samples.	Brand.	Manufacturer.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.
	1. Flour					
1	Red Dog	Bay State Milling Co., Winona, Minn.	17.72	17.25	4.10	3.00
1		Buffalo Cereal Co., Buffalo, N. Y.	16.78	—	4.03	—
1	Red Dog	Wm. G. Crocker, Minneapolis, Minn.	20.54	17.00	5.20	5.00
2	Superb Red Dog	Eagle Roller Mill Co., New Ulm, Minn.	20.23	16.00	5.88	4.80
1	Ben Hur	Hennepin Mill Co., Buffalo, N. Y.	19.00	—	5.25	—
1	Powerful Red Dog	A. B. McCrillis & Son Co., Boston	19.50	20.25	5.60	5.25
1	Powerful	" " " "	18.91	15.50	5.87	4.50
1	XXX Comet	Northwestern Consolidated Milling Co., Minneapolis	20.54	16.50	5.80	4.00
1		" " " " "	18.74	16.25	5.28	5.25
1	A	Pillsbury's Mills, Minneapolis	18.09	15.00	5.10	4.50
1	A	" " "	18.48	16.00	4.61	5.00
1	XX Daisy	" " "	19.99	16.00	5.75	4.50
1		Russell-Miller Milling Co., Minneapolis	17.82	16.00	4.96	5.00
1		Southwestern Milling Co., Kansas City, Mo.	19.44	14.50	4.65	5.00
1		Thornton & Chester Milling Co., Buffalo, N. Y.	16.81	14.00	4.56	3.00
1	Adrian	Washburn-Crosby Co., Minneapolis	18.36	17.00	4.93	5.00
1	Arlington	" " " "	17.69	—	3.67	—
		Highest	20.54	—	5.88	—
		Lowest	16.78	—	3.67	
		Average	18.32	—	5.12	—
	2. Standard.					
1		American Hominy Co., New York	13.93	—	3.68	—
1	William Tell	Ansted & Burke Co., Springfield, Ill.	17.74	14.50	4.78	4.00
1	Shipstuff	Ballard & Ballard, Louisville, Ky.	16.92	16.45	4.07	4.60
2		Barber Milling Co., Minneapolis, Minn.	18.79	14.00	5.51	4.00
1		L. G. Campbell Milling Co., Blooming Prairie, Minn.	19.29	—	6.15	—
1	Nodak	Chaffee-Miller, Casselton, North Dakota	18.47	16.40	6.11	5.70
1	Commander	Commander Mill Co., Minneapolis, Minn.	18.53	16.00	5.79	4.50
1	Wirthmore	Chas. M. Cox Co., Boston	18.30	15.00	5.41	4.00
1		Crocker Milling Co., Minneapolis, Minn.	18.64	15.00	6.12	4.00
1		Davis & Co., Rochester, N. Y.	20.19	—	5.31	—
1	Apex	Detroit Milling Co., Detroit, Mich.	17.25	17.00	4.92	5.00
1	Superior	Duluth-Superior Milling Co., Duluth, Minn.	18.47	16.00	5.08	5.00
3		Eckhardt & Swan Milling Co., Chicago	17.01	15.00	4.50	4.00
1	Lucky	Federal Milling Co., Lockport, N. Y.	19.31	14.00	6.40	4.00
2	H	Hecker-Jones-Jewell Milling Co., New York.	17.54	17.30	5.06	6.05
1	Ben Hur	Hennepin Mill Co., Minneapolis	17.11	16.00	4.79	4.00
1		J. H. Hinds Co., Rochester, N. Y.	18.07	17.50	5.21	5.30
1		C. Hoffman & Son, Enterprise, Kansas	19.13		4.99	
1		Hubbard Milling Co., Mankato, Minn.	18.49	14.50	6.22	5.10
1	Interstate	Hunter-Robinson-Wenz Milling Co., St. Louis, Mo.	16.67	14.50	4.00	4.00
1	Carnation Gray	Kempler Mill & Elevator Co., Kansas City, Mo.	18.56	16.00	5.28	4.00
2		Lyon & Greenleaf, Wauseon, Ohio.	17.61		4.74	
1	Powerful	A. B. McCrillis & Son Co., Boston	16.65	15.75	6.00	5.25
2		Millbourne Mills, Philadelphia, Pa.	16.97	14.00	4.03	4.00

*There is no sharply drawn line between the different grades of middlings. Owing to different milling processes and the difference in the resulting by-products, any attempt to classify the different grades is unsatisfactory.

WHEAT MIDDLINGS—Continued

No. sample		Manufacturer.	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.
[illegible]		Minot Flour Mill Co., Minot, N. D.	18 87	—	4 92	—
[illegible]		Mosely & Motley Milling Co., Rochester, N. Y.	18 79	—	5 65	—
[illegible]		National Feed Co., St. Louis, Mo.	16 42	16 00	4 66	4 00
[illegible]		Niagara Falls Milling Co., Niagara Falls, N. Y.	17 88	—	5 62	—
[illegible]		Northwestern Milling Co., Little Falls, Minn.	15 92	15 75	5 26	5 25
[illegible]	A	Pillsbury's Mills, Minneapolis	17 34	15 00	4 99	4 50
[illegible]	B	" " "	17 64	15 00	5 33	4.50
[illegible]		Geo. P. Plant Milling Co., St. Louis, Mo.	19 69	17 11	5 97	4 41
[illegible]		Quality Mills, Enterprise, Kansas	17 95	16 65	4.55	4 75
[illegible]		James Quirk Milling Co., Montgomery, Minn.	17 97	17 25	5.92	5 25
[illegible]	Tekonsha	A. H. Randall Mill Co., Tekonsha, Mich.	16 30	14 00	4 27	4 00
[illegible]		Star & Crescent Milling Co., Chicago, Ill.	17.58	18.00	5 45	4 00
[illegible]		S. Stewart, Morris, Minn.	17.51	16 40	5 58	5 50
[illegible]	Pennant	David Stott, Detroit, Mich.	20 58	17 00	5.46	5 50
[illegible]		Thompson Milling Co., Lockport, N. Y.	18 47	—	5 57	—
[illegible]		Thornton & Chester Milling Co., Buffalo, N. Y.	15 97	14 00	4 54	3 00
[illegible]		Voight Milling Co., Grand Rapids, Mich.	15 80	—	4 17	—
[illegible]		Washburn-Crosby Co., Buffalo, N. Y.	18 40	—	5.41	—
[illegible]	Black Hawk	Western Flour Mill Co., Davenport, Iowa.	18 42	16 00	5.98	4 75
		Highest	20 19	—	6 43	—
		Lowest	13 93	—	3.88	—
		Average	17 58	—	5.20	—

WHEAT MIXED FEED.

Definition. Wheat mixed feed is a mixture of the wheat by-products obtained in the milling of wheat. Some brands contain more middlings than others.

No. sample		Manufacturer.	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.
[illegible]	Acme	Acme-Evans Co., Indianapolis, Ind.	17 67	15 00	4 07	4 00
[illegible]		Akin-Erskine Milling Co., Evansville, Ind.	17 03	16 72	3 93	4 01
[illegible]	Amendt	Amendt Milling Co., Monroe, Mich.	17 83	—	5 04	—
[illegible]		E. W. Bailey, Montpelier, Vt.	17 08	—	4 47	—
[illegible]	Banner	Banner Milling Co., Buffalo, N. Y.	17.70	—	5 82	—
[illegible]	White Satin	Barber Milling Co., Minneapolis, Minn.	17 68	16.00	5 47	4 50
[illegible]	Durum	Bemmels Milling Co., Lisbon, N. Dak.	15 40	14 00	4 83	5.00
[illegible]	Big Diamond	Big Diamond Milling Co., Minneapolis, Minn.	16 80	15.80	4 77	4.40
[illegible]	Bulls Eye	Blish Milling Co., Seymour, Ind.	17 09	16 00	4.07	4 50
[illegible]		C. W. Bowker & Co., Worcester	17 47	16.00	4.62	4.00
[illegible]	All Right	Burbeck & Brett, No. Abington	17 13	15.00	5.19	4 00
[illegible]		J. Andrew Cain, Versailles, Ky.	16.67	15 00	4 07	4 25
[illegible]	Boston	Chapin & Co., Boston	15 20	14 00	4 34	3 00
[illegible]	Erie	" " "	17 03	16 00	4 21	3 00
[illegible]	Pine Tree	"	16 61	14.00	4 32	3 50
[illegible]	Rutland	"	17.45	14.00	5 43	4 00
[illegible]	Vermont	"	17.99	14.00	4 36	4.00
[illegible]	[illegible]	Claro Milling Co., Lakeville, Minn.	17.50	15 00	5.75	3.00
[illegible]		Commercial Milling Co., Detroit, Mich.	15 05	14 61	5 01	4.65
[illegible]	Commander	Commander Mill Co., Minneapolis, Minn.	16 99	15 50	5.79	4.75
[illegible]	Columbia	Chas. M. Cox Co., Boston	16.90	—	5 12	—
[illegible]	Eagle	" " " "	15 90	14 00	4 17	3 00

WHEAT MIXED FEED (Continued).

No. Samples.	Brand.	Manufacturer	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.
4	Regent	Chas. M. Cox Co., Boston	17 41	15 00	5 00	3 00
3	Samoset	" " " "	17 10	—	4 65	-
4	Wirthmore	" " " "	17 19	16 00	4 44	4 00
1		" " " "	16 72	—	4 42	-
1	Adrian	Detroit Milling Co., Adrian, Mich.	16 69	17 50	3 76	5 00
3	Boston	Duluth Superior Milling Co., Duluth, Minn.	17 33	16 00	5 19	4 50
2	Eagle	Eagle Roller Mills, Inc., Lawrenceburg, Ky.	16 46	.	4 04	
2		Eckhardt & Swan Milling Co., Chicago.	16 60	-	4 04	
1		Elk River Milling Co., Elk River, Minn.	16 76	-	5 40	–
1	Eaco Winged Horse	Everett-Aughenbaugh & Co., Waseca, Minn.	16 67	15 00	5 42	3 00
2	Lucky	Federal Milling Co., Lockport, N. Y.	17 42	14 00	5 50	4 50
3	Garland	Garland Milling Co., Greensburg, Ind.	17 06	15 25	4 05	3 75
2		Glen Mills Cereal Co., Rowley	16.00	—	3.97	—
2	Royal	Gopher State Milling Co., Little Falls, Minn.	16 46	14 02	5 15	4 00
1	Xtragood	Griswold & Mackinnon, St. Johnsbury, Vt.	17.69	—	5.37	- -
1		Gwinn Milling Co., Columbus, Ohio	17 29	16 39	4.23	4 50
1	Red Star	Hannibal Milling Co., Hannibal, Mo.	16 11	14 00	4 35	4 00
1	New York	Hecker-Jones-Jewell Milling Co., New York	15 70	16 69	3 95	6.10
1		C. Hoffman & Son, Enterprise, Kansas	16 17	—	4 57	—
1	Sunshine	Hunter Bros. Milling Co., St. Louis, Mo.	17 61	15 00	4 40	4 00
2	Matchless	" " " " " "	16.20	15 00	4 23	4 00
5	Certified	Hunter-Robinson & Wenz Milling Co., St. Louis	17.16	14.50	4 30	4 00
2	Sunshine	" " " " " "	14.59	14 50	4.36	4 00
2	Wildfire	" " " " " "	16.33	14 50	4 17	4 00
2		Kehlor Flour Mills Co., St. Louis, Mo.	17 34	14 00	4 37	4 00
3	Crescent	Kempler Mill & Elevator Co., Kansas City, Mo.	17 10	15 00	4.16	4 00
1	Eastern	" " " " " " "	16.55	17 00	3 27	3 50
4	Snowflake	Lawrenceburg Roller Mills Co., Lawrenceburg, Ind.	17.46	15 20	3 92	4 30
1		Liberty Mills, Nashville, Tenn.	17.32	16 00	4 60	4 00
2		Lidgeswood Mills Co., Lidgeswood, N. Dak.	16 59	14 40	4 37	4 40
2	Lexington	Lexington Roller Mills, Lexington, Ky.	16 92	—	4 37	—
1	Thoroughbred	" " " " "	16 51	- -	4 02	—
2		Lyon & Greenleaf, Wauseon, Ohio	16.95		4 60	—
1	Extra Macceo	A. B. McCrillis & Son Co., Boston	16 52	15 09	4 47	5 67
1	Extra Powerful	" " " " "	17 91	15 00	4 93	5 25
1	Powerful	" " " " "	17 46	16 50	4 69	5 25
1	King	R. P. Moore Milling Co., Princeton, Ind.	17.70	15 00	4 16	5 00
1	Pennant	National Milling Co., Toledo, Ohio	16 42	- -	3 30	—
1	Osota	" " " " "	17 26	- -	5 20	—
3		" " " " "	16 39	—	3 00	—
1	Northland	Northland Milling Co., Larimore, N. Dak.	16 55	15 30	5 16	4 40
2		Northwestern Milling Co., Little Falls, Minn.	16 35	14 02	4 93	4 00
2	Planet	Northwestern Consolidated Milling Co., Minneapolis	16 74	15.00	5 09	4 00
1	Durum	Oakes Flour Mills, Oakes, N. Dak.	15 66	12 10	4 60	6 00
4	Fancy	Pillsbury Mills, Minneapolis, Minn.	17 06	16 00	4 30	4 50
1	Tally Ho	" " " "	17.95	15 00	4 71	4 50
2	Buckeye	Quaker Oats Co., Chicago, Ill.	16 29	- -	4 30	—
2	Regular	Russell Flour Co., Albany, N. Y.	16 20	15 00	5 01	4 50
3	Occident	Russell-Miller Milling Co., Minneapolis, Minn.	16 01	15 00	5 37	4 50
3	Gold Mine	Sheffield-King Milling Co., Minneapolis, Minn.	17 15	16 50	5 23	4 50
5	Try Me	Sparks Milling Co., Alton, Ill.	17 31	17 15	4 64	4 45

WHEAT MIXED FEED—(Continued).

No. Samples.	Brand.	Manufacturer.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.
2	Wabash	Sparks Milling Co., Terre Haute, Ind.	16.79	—	4.44	—
1		Star & Crescent Milling Co., Chicago, Ill.	17.31	15.00	4.83	4.50
4	Honest	David Stott, Detroit, Mich.	16.67	—	4.90	—
1	Heavy	" " " "	16.27	16.00	4.64	5.00
1		Stratton & Co., Concord, N. H.	15.76	—	4.74	—
4		Thornton & Chester Milling Co., Buffalo, N. Y.	17.56	14.00	5.18	3.00
2	Valier	Valier & Spies Milling Co., Marine, Ill.	16.66	15.00	4.96	4.00
1	Farmer's Friend Vimco	Valley City Milling Co., Grand Rapids, Mich.	16.88	15.22	4.59	4.47
1	Superior	Washburn-Crosby Co., Minneapolis	17.34	16.00	5.52	4.50
1	Webster	Webster Mill Co., Webster, So. Dak.	16.69	—	5.03	—
1	Best	Whitman Grain & Coal Co., Whitman	18.60	16.00	5.38	4.00
2	Kent	Williams Bros. Co., Kent, Ohio	16.47	12.00	4.43	2.00
2	Searchlight	Wisconsin Milling Co., Menominie, Wis.	16.02	16.19	5.50	5.17
		Highest	18.74	—	5.82	—
		Lowest	15.05	—	3.27	—
		Average	16.97	—	4.71	—

WHEAT BRAN.

Definition. Wheat bran is the coarse outer coating of the wheat berry.

No. Samples.	Brand.	Manufacturer.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.
1		Allen Baker Commission Co., St. Louis, Mo.	16.55	14.00	4.80	4.00
1		Ashton Flouring Mills Co., Ashton, So. Dak.	16.64	13.00	5.53	4.00
1	Atlas	Atlas Flour Mills, Milwaukee, Wis.	17.36	15.00	5.15	3.30
3		Ballard & Ballard, Louisville, Ky.	16.35	15.78	3.98	4.42
2	Flakes	Barber Milling Co., Minneapolis, Minn.	17.35	13.00	5.50	4.00
2	Winona	Bay State Milling Co., Winona, Minn.	15.71	15.00	4.90	5.16
1		A. H. Brown & Bros., Boston	15.92	15.50	5.19	4.75
1		L. G. Campbell Milling Co., Blooming Prairie, Minn.	16.00	14.70	4.96	4.50
1		Chapin & Co., St. Louis, Mo.	17.55	14.00	4.38	3.00
1		L. Christian, Minneapolis, Minn.	16.78	15.00	5.23	4.00
1	Jersey	Geo. C. Christian, Minneapolis, Minn.	15.49	13.00	4.91	4.00
1		Wm. A. Coombs Milling Co., Coldwater, Mich.	15.13	14.00	4.32	3.00
1	Commander	Commander Mill Co., Minneapolis, Minn.	15.69	14.00	4.95	4.00
1		Wm. G. Crocker, Minneapolis, Minn.	15.63	14.50	6.09	4.00
1		J. G. Davis Co., Rochester, N. Y.	16.46	—	5.14	—
1	Duluth Imperial	Duluth Superior Milling Co., Duluth, Minn.	16.68	14.50	4.86	4.00
2		Farmer's Milling Co., Cold Springs, Minn.	14.39	14.00	4.34	3.00
2	Lucky	Federal Milling Co., Lockport, N. Y.	16.66	14.00	5.02	4.00
1		Flavelle Milling Co., Lindsay, Ontario	17.07	—	3.36	—
1	Clover Leaf	Gardner Mill, Hastings, Minn.	16.12	13.50	2.95	4.50
1		Gwinn Milling Co., Columbus, Ohio	17.05	—	4.35	—
1	100 Per Cent	" " " " "	16.99	15.79	3.95	4.40
1		Hecker-Jones-Jewell Milling Co., New York	15.49	14.95	4.66	5.35
1	Ben Hur	Hennepin Mill Co., Minneapolis, Minn.	16.31	14.50	5.74	4.00
1		C. Hoffman & Son, Enterprise, Kansas	17.51	—	4.15	—
1	Dreadnaught	Hunter-Robinson-Wenz Milling Co., St. Louis, Mo.	14.72	14.50	3.74	4.00
1		W. J. Jennison Co., Minneapolis, Minn.	16.37	15.00	4.76	4.00
2	Diamond	Kempler Mill & Elevator Co., Kansas City, Mo.	17.41	14.50	4.69	4.00

WHEAT BRAN—(Continued).

No. Samples.	Brand.	Manufacturer.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.
2		Lyon & Greenleaf, Wauseon, Ohio	15.36		4.22	
2	Powerful	A. B. McCrillis & Son Co., Boston	16.31	14.50	5.41	4.00
1		Northwestern Milling Co., Little Falls, Minn.	15.03	12.50	5.03	3.70
3	Bell Cow	Quaker Oats Co., Chicago, Ill.	16.34	-	5.65	
1		Russell-Miller Milling Co., Minneapolis, Minn.	17.38	13.00	6.17	4.00
1	Robin Hood	Saskatchewan Flour Mills Co., Ltd., Moose Jaw, Sask.	16.64		5.76	
1	Try Me	Sparks Milling Co., Alton, Ill.	17.35	14.50	4.69	4.00
1		Star & Crescent Milling Co., Chicago, Ill.	17.30	15.00	5.16	4.00
1		S. Stewart, Morris, Minn.	15.64	15.00	5.19	4.00
1		F. W. Stock & Sons, Hillsdale, Mich.	16.12	—	4.05	
1		David Stott, Detroit, Mich.	17.28	16.00	4.47	4.00
1		" " " "	13.11	—	5.26	-
1		Webster Mill Co., Webster, So. Dak.	16.69	—	5.57	-
1	Black Hawk	Western Flour Mill Co., Davenport, Iowa	16.28	14.00	4.89	4.35
		Highest	17.86		6.17	
		Lowest	14.39		2.95	-
		Average	16.50		4.86	-

ADULTERATED WHEAT FEEDS.

Definition. Adulterated wheat feeds are wheat products to which has been added material derived from some other source than wheat.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
1. Middlings.							
New Occident Mfg. Co., Minneapolis, Minn.							
*Aloras,	F. F. Woodward & Co.	Fitchburg	16.07	16.00	7.46	5.00	8.75
2. **Mixed Feed.							
Indiana Mlg. Co., Terre Haute, Ind.							
Holstein,	E. C. Packard	Brockton	11.99	13.00	3.67	3.50	15.88
Holstein,	Mackenzie & Winslow	Fall River	12.28	12.00	3.89	3.00	15.44
Jersey,	W. J. Meek	Fall River	11.28	10.00	2.39	2.50	15.69
Jersey,	Cutler Grain Co	S. Framingham	13.62	12.00	3.60	3.00	13.49
Sterling,	O. F. Metcalf & Son	Franklin	11.89	11.50	2.83	3.00	13.72
Sterling,	H. K. Webster Co.	Lawrence	11.40	13.00	2.97	3.50	15.07
Sterling,	J. W. Doon & Son	Natick	11.80	11.50	2.66	3.00	14.51
Henry Jennings, Boston.							
Daisy,	J. H. Nye	Brockton	12.02	11.00	2.75	3.00	13.61
Daisy,	L. A. Snow	Upton	13.32	11.00	3.33	3.00	12.39
Daisy,	Worcester Hay & Gr. Co.	Worcester	11.74	11.00	2.91	3.00	14.65
A. Waller & Co., Henderson, Ky.							
Blue Grass,	J. A. Bouvier	New Bedford	11.14	8.00	2.39	2.00	10.56
Blue Grass,	F. G. Cover & Co.	Lowell	11.85	8.00	3.02	2.00	14.62
Blue Grass,	Cutler Co.	N. Wilbraham	12.20	9.00	3.46	2.00	14.94
Blue Grass,	Smith Feed Co.	Westfield	11.89	9.00	3.65	2.00	14.93
Blue Grass,	E. A. Cowee	Worcester	10.66	8.00	2.79	3.00	14.05
Oneida,	Taunton Teaming Co.	Taunton	11.83	10.00	3.59	2.50	14.93
	Average		11.94	—	3.18	—	14.28

*Contains ground screenings.
**Contains ground corn cob.

DAIRY FEEDS.

Definition. Dairy feeds are proprietary feeds consisting of a mixture of several feeding stuffs and containing 15 or more per cent protein.

J. Bibby & Sons, Liverpool, Eng.							
Oil Cake Feed,	Dennison Plummer & Co.	New Bedford	19.92	16.00	8.57	7.00	7.43
J. W. Biles Co., Cincinnati, Ohio.							
Ubiko Horse Feed,	Red Mills Feed Co.	Ashley Falls	18.25	13.00	7.58	6.00	6.91
Ubiko Horse Feed,	C. G. Burnham	Holyoke	19.74	16.00	7.62	6.00	8.28
Ubiko Union Grains,	Wallace Grain Co.	Clinton	24.02	24.00	8.09	7.00	9.09
Ubiko Union Grains,	Blood Bros.	Medfield	25.80	24.00	7.52	7.00	9.03
Ubiko Union Grains,	Hathaway & Mackenzie	New Bedford	24.01	24.00	6.68	7.00	3.57
Ubiko Union Grains,	S. L. Davenport & Son	N. Grafton	25.13	24.00	7.81	7.00	9.41
Buffalo Cereal Co., Buffalo, N. Y.							
Creamery Feed,	A. M. Butler	Avon	20.86	18.00	5.17	4.00	9.26
Creamery Feed,	Griffin Bros.	Fall River	19.88	13.00	6.06	4.00	9.54
Creamery Feed,	A. Culver Co.	Rockland	19.22	13.00	5.53	4.00	9.73
Dairy Feed,	Chamberlain & Barnes	Sturbridge	15.44	12.00	4.31	3.00	9.47
Chapin & Co., Milwaukee, Wis.							
Unicorn Dairy Ration,	B. W. Brown	Concord	25.97	26.00	6.31	5.50	8.85
Unicorn Dairy Ration,	E. J. Adams	Gt. Barrington	26.09	26.00	6.58	5.50	7.92
Unicorn Dairy Ration,	S. L. Davenport & Son	N. Grafton	24.88	26.00	4.91	5.50	8.44
Unicorn Dairy Ration,	I. J. Rowell	Pepperell	24.57	26.00	6.37	5.50	9.13
H. O. Mills, Buffalo, N. Y.							
Algrane,	W. T. McLaughlin	W. Roxbury	19.57	14.00	3.66	4.00	11.71
Algrane,	Lenox Coal Co.	Lenoxdale	13.07	14.00	3.14	4.00	11.70
Husted Milling Co., Buffalo, N. Y.							
Husted's,	J. E. Camp & Sons	Caryville	25.19	18.00	5.60	3.00	7.42
North West Mills Co., Winona, Minn.							
Sugarota,	J. Burkhardt	Beverly	25.50	25.00	3.51	6.00	11.12
Sugarota,	J. H. Nye	Brockton	25.41	25.00	3.01	6.00	11.26
Sugarota,	F. W. Dorr & Co.	Newton Center	25.83	25.00	3.24	6.00	11.72
Ropes Bros., Salem.							
Horse Feed,	Ropes Bros.	Salem	17.43	16.00	5.18	5.00	3.52

DAIRY FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
St. Albans Grain Co., St. Albans, Vt.							
Paragon,	A. Culver Co.	Rockland	23.07	23.00	6.57	5.00	9.60
Wirthmore,	C. P. McClanathan	Barre Plains	25.92	26.00	6.20	5.00	9.33
Wirthmore,	Whitney Coal & Gr. Co.	N. Adams	26.85	26.00	5.37	5.00	9.55
Wirthmore,	Whitney Coal & Gr. Co.	N. Adams	25.95	26.00	6.05	5.00	9.20
Wirthmore,	A. Culver Co.	Rockland	23.39	26.00	4.35	5.00	9.35

MOLASSES FEEDS.

Definition. Molasses feeds are mixtures of molasses, low grade milling offal and high grade feeding stuffs.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
American Mlg. Co., Chicago, Ill.							
Sucrene Dairy,	Milford Grain Co.	Milford	16.17	16.50	4.54	3.50	13.37
Sucrene Dairy,	H. A. Crossman	Needham	17.29	16.50	3.73	3.50	13.07
Sucrene Dairy,	Dennison Plummer Co.	New Bedford	16.90	16.50	4.02	3.50	12.25
Sucrene Horse,	Prentiss, Brooks & Co.	Easthampton	10.77	10.00	2.92	3.00	14.48
Sucrene Horse,	G. Methe & Sons	Springfield	9.17	10.00	2.36	3.00	11.24
Great Western Cereal Co., Chicago, Ill.							
Daisy,	Evans & Bowker	Baldwinsville	15.24	15.00	2.72	3.00	12.85
Daisy,	G. F. Wetherbee Est.	Gardner	17.62	15.00	2.37	3.00	13.57
Daisy,	Thatcher & Ireland	Littleton	15.14	15.00	2.49	3.00	12.88
Daisy,	T. Jacobsen	N. Dartmouth	16.14	15.00	2.95	3.00	15.04
Husted Milling Co., Buffalo, N. Y.							
Husted's,	W. J. Meek	Fall River	18.83	13.00	3.56	4.00	7.35
Husted's,	A. M. Haggart	Franklin	13.60	13.00	3.99	4.00	5.90
Husted's,	H. L. Patrick	Hopedale	22.51	13.00	5.13	4.00	7.43
Husted's,	W. K. Gilmore & Sons	Walpole	19.92	18.00	4.87	4.00	7.94
Chas. A. Krause Mlg. Co., Milwaukee, Wis.							
Badger,	T. Jacobsen	N. Dartmouth	13.51	16.00	2.59	3.50	13.19
Badger,	N. Hatfield Grain Co.	N. Hatfield	14.90	16.00	3.16	3.50	12.02
Badger,	H. C. Puffer Co.	Springfield	15.94	16.00	1.18	2.00	13.50
Badger,	A. N. Whittemore.	Worcester	13.23	16.00	1.84	3.50	13.45
North West Mills Co., Winona, Minn.							
Sugarota Dairy,	P. M. Eaton & Co.	Williamstown	14.81	16.00	3.93	3.00	13.37
Sugarota Horse,	J. E. Merrick & Co.	Amherst	10.90	12.00	3.40	3.00	17.73
Sugarota Horse,	J. Burkhardt	Beverly	10.59	10.00	1.47	3.00	16.18
Sugarota Horse,	F. W. Dorr & Co.	Newton Center	10.24	10.00	3.80	3.00	14.39
Quaker Oats Co., Chicago, Ill.							
Quaker,	F. Knight	Charlton	17.30	16.00	3.05	3.50	14.77
Quaker,	Hobart Mills	E. Braintree	13.07	16.00	4.03	3.50	19.41
Quaker,	E. A. Kellogg & Son	Feeding Hills	14.32	16.00	3.57	3.50	16.99
Quaker,	W. R. Ross & Co.	Holyoke	13.03	16.00	3.42	3.50	14.39
Quaker,	Mansfield M g. Co.	Mansfield	17.33	16.00	3.05	3.50	14.20
Quaker,	H. A. Crossman	Needham	14.88	16.00	3.26	3.50	13.37
Quaker,	C. E. Terry	W. Springfield	16.63	16.00	4.13	3.50	16.78
Western Grain Products Co., Hammond, Ind.							
Hammond Dairy,	F. G. Cover & Co.	Lowell	15.29	17.00	3.49	3.00	13.55
Hammond Dairy,	F. G. Cover & Co.	Lowell	17.25	17.00	2.80	3.00	9.72
Hammond Dairy,	Berkshire Coal & Gr. Co.	N. Adams	19.35	17.00	4.01	3.00	10.00

RYE FEEDS.

[illegible] Rye feeds are by-products obtained in the manufacture of flour from rye.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
Boutwell Mlg. & Grain Co., Troy, N. Y.						
F. Knight	Charlton	[illegible]	[illegible]	[illegible]	[illegible]	3.86
C. G. Burnham	Holyoke	[illegible]	[illegible]	[illegible]	[illegible]	—
Prentiss, Brooks & Co.	Westfield	14.[illegible]	[illegible]	[illegible]	[illegible]	—
J. B. Garland & Son	Worcester	[illegible]	[illegible]	[illegible]	[illegible]	4.64
J. B. Garland & Son	Worcester	14.[illegible]	[illegible]	[illegible]	[illegible]	—
Brickett Mills, Penn Yan, N. Y.						
H. C. Puffer Co.	Springfield	[illegible]	[illegible]	[illegible]	[illegible]	3.95
Cutler Co., No. Wilbraham.						
Smith Feed Co.	Westfield	[illegible]	[illegible]	[illegible]	[illegible]	—
Cutler Co.	N. Wilbraham	14.[illegible]	[illegible]	[illegible]	[illegible]	—
Geo. T. Callahan, Castleton, N. Y.						
G. L. Turner	Chester	[illegible]	[illegible]	2.44	2.00	—
Washburn & Crosby Co., Minneapolis, Minn.						
C. E. Terry	W. Springfield	[illegible]	14.00	[illegible]	[illegible]	[illegible]

CALF MEAL.

Definition. Calf meal is a proprietary mixture intended as a feed for young calves.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
Blatchford Calf Meal Factory, Waukegan, Ill.							
Blatchford's.	Greene Coal Co.	Campello	[illegible]	[illegible]	4.37	[illegible]	[illegible]
Blatchford's.	M. H. Rolfe Est.	Newburyport	[illegible]	[illegible]	[illegible]	[illegible]	4.42
Great Western Cereal Co., Chicago, Ill.							
Gregson.	C. Bond	Charlton	[illegible]	[illegible]	7.47	[illegible]	4.67
Gregson.	R. W. Davies	Greenfield	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gregson.	R. W. Davies	Greenfield	[illegible]	[illegible]	6.75	[illegible]	[illegible]
North West Mills Co., Winona, Minn.							
[illegible]	C. Burkhardt	Beverly	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] H. Nye	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.22
[illegible]	Morse Bros.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Quaker Oats Co., Chicago, Ill.							
Schumacher's	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Schumacher's	[illegible]	Springfield	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

II STARCHY CARBOHYDRATE FEEDS

CORN MEAL

Manufacturer or Jobber, Brand and Retailer		Town					
Ground by Retailer.							
	E. J. Adams	[illegible]	[illegible]		[illegible]		[illegible]
	E. A. Briggs Co.	Amherst	[illegible]		[illegible]		[illegible]
	F. G. Carver & Co.	[illegible]	[illegible]		[illegible]		[illegible]
	J. O. Dean & Co.	[illegible]	[illegible]		[illegible]		[illegible]
	J. O. Dean & Co.	[illegible]	[illegible]		[illegible]		[illegible]
	Dennison [illegible] Co.	New Bedford	[illegible]		[illegible]		[illegible]
	F. Diantz	[illegible]	[illegible]		[illegible]		[illegible]
	Dodge Mill Co.	[illegible]	[illegible]		[illegible]		[illegible]
	J. O. Elliott & Co.	[illegible]	[illegible]		[illegible]		[illegible]
	Greene Coal Co.	[illegible]	[illegible]		[illegible]		[illegible]
	H. W. Hill & Co.	Williamsburg	[illegible]		[illegible]		[illegible]
	Hingham Grain Mill, Inc.	Hingham	[illegible]		[illegible]		[illegible]
	Hobart Mills	[illegible]	[illegible]		[illegible]		[illegible]
	W. Lord	[illegible]	[illegible]		[illegible]		[illegible]
	W. Lord	[illegible]	[illegible]		[illegible]		[illegible]
	Marlboro Grain Co.	Marlboro	[illegible]		[illegible]		[illegible]
	Marlboro Grain Co.	Marlboro	[illegible]		[illegible]		[illegible]
	W. J. Meek	Fall River	[illegible]		[illegible]		[illegible]
	Milford Grain Co.	Milford	[illegible]		[illegible]		[illegible]
	Morse Bros.	[illegible]	[illegible]		[illegible]		[illegible]
	T. A. [illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	E. [illegible] Packard	[illegible]	[illegible]		[illegible]		[illegible]
	C. O. Parmenter & Co.	[illegible]	[illegible]		[illegible]		[illegible]
	Peterson Coal & Ice Co.	[illegible]	[illegible]		[illegible]		[illegible]
	Potter Grain Co.	Shelburne Falls	[illegible]		[illegible]		[illegible]
	A. R[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	Scott Grain Co.	Amesbury	[illegible]		[illegible]		[illegible]
	[illegible] & Co.	[illegible]	[illegible]		[illegible]		[illegible]
	H. K. Webster Co.	Lawrence	[illegible]		[illegible]		[illegible]
	M. H. Williams	[illegible]	[illegible]		[illegible]		[illegible]
	A. H. Wood & Co.	Framingham	[illegible]		[illegible]		[illegible]
	F. F. Woodward & Co.	[illegible]	[illegible]		[illegible]		[illegible]
Amendt Mlg. Co., Monroe, Mich.							
[illegible]	A. Carr	[illegible]	[illegible]		[illegible]		[illegible]
American Hominy Co., Indianapolis, Ind.							
Feed Meal	D. H. Craig	[illegible]	[illegible]		[illegible]		[illegible]
E. W. Bailey & Co., Montpelier, Vt.							
	[illegible]	Amherst	[illegible]		[illegible]		[illegible]
Buffalo Cereal Co., Buffalo, N. Y.							
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
[illegible] Cushing & Co., Fitchburg.							
	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
Cutler & Co., No. Wilbraham.							
	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
General Flour & Feed Co., Buffalo, N. Y.							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Husted Mlg. Co., Buffalo, N. Y.							
	F. Diantz	[illegible]	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
Malden Grain Co., Malden.							
	Malden Grain Co.	Malden	[illegible]		[illegible]		[illegible]
Meech & Stoddard, Middletown, Ct.							
	A. [illegible] & Son	[illegible]	[illegible]		[illegible]		[illegible]
Narragansett Mlg. Co., E. Providence, R. I.							
A. [illegible]	[illegible]	[illegible]	[illegible]		[illegible]		
R. [illegible]	A. M. Reed	[illegible]	[illegible]		[illegible]		[illegible]

CORN MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Quaker Oats Co., Chicago, Ill.							
Buckeye,	Prentiss, Brooks & Co.	Easthampton	8.14	—	1.00	—	.82
Feed Meal,	A. D. Potter	Orange	9.83	9.00	7.63	4.00	3.43
Smith, Northam & Co., Hartford, Ct.							
	H. A. Crossman	Needham	8.60	--	4.06	--	1.54
Whitman Coal & Grain Co., Whitman.							
	Phillips, Bates & Co.	Hanover	8.16	--	2.20	-	--
	Average		8.55	—	3.81	—	1.84

GROUND OATS.

Ground by Retailer.							
	U. S. Adams	Townsend	12.07	--	4.31	--	8.93
	E. A. Briggs Co.	Attleboro	12.34	--	3.62	—	7.07
	W. E. Bryant & Co.	Brockton	12.69	--	4.72	—	9.43
	J. O. Dean & Co.	S. Easton	11.64	--	4.25	—	8.13
	Dennison Plummer Co.	New Bedford	11.25	—	4.63	—	7.57
	J. W. Doon & Son	Natick	12.57	--	5.41	—	5.87
	Hingham Grain Mill Co.	Hingham	11.33	--	4.76	—	—
	Marlboro Grain Co.	Marlboro	12.03	--	4.46	-	9.49
	A. H. Wood & Co.	Framingham	12.48		5.42	-	9.00
Cutler Co., No. Wilbraham.							
	Smith Feed Co.	Westfield	12.55	-	5.46	--	7.84
Smith, Northam & Co., Inc., Hartford, Ct.							
	J. F. Ray	Franklin	11.06		4.21	-	7.99
	J. F. Ray	Franklin	11.38	-	4.74		12.08
W. N. Potter & Sons, Greenfield.							
	A. D. Potter	Orange	12.60	-	4.68	-	8.92
	Average		11.98	-	4.82	--	8.53

RYE MEAL.

Ground by Retailer.							
	Glen Mills Cereal Co.	Rowley	11.38	--	1.72	--	--
	E. C. Packard	Brockton	11.00	--	1.88	-	1.89
	H. K. Webster Co.	Lawrence	11.17	--	1.79	--	-
Potter & Wrightington, Boston.							
	A. Dodge & Sons Corp.	Beverly	11.06	--	1.93	-	

HOMINY MEAL.

Definition. Hominy meal, feed or chop is a by-product in the manufacture of hominy grits from corn, and consists of the hull and corn germ together with a considerable portion of the corn starch.

American Hominy Co., Indianapolis, Ind.							
Homco,	E. C. Packard	Brockton	10.05	8.50	6.89	7.70	-
American Rice and Cereal Co., Keokuk, Iowa.							
Purity,	J. Franks	New Bedford	10.71	10.00	8.50	7.34	
M. F. Baringer, Philadelphia, Pa.							
	W. N. Potter & Sons	Greenfield	10.84	9.00	9.07	6.00	
Buffalo Cereal Co., Buffalo, N. Y.							
	Scott Grain Co.	Amesbury	10.28	10.25	7.24	8.00	--
	A. M. Butler	Avon	10.00	10.00	5.55	7.00	2.92
	Wallace Grain Co.	Clinton	9.93	10.00	6.74	7.00	3.34
	Griffin Bros.	Fall River	10.01	10.00	8.28	7.00	—
	Griffin Bros.	Fall River	10.04	10.00	6.70	7.00	3.13
	W. M. Baylies	New Bedford	9.97	10.25	7.30	8.00	--
	Chamberlain & Barnes	Sturbridge	11.06	10.00	7.94	7.00	—
	L. A. Snow	Upton	10.12	10.00	7.82	7.00	3.85

HOMINY MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Chapin & Co., Boston.							
Niagara,	J. H. Nye	Brockton	10.23	10.00	8.08	7.00	
C. M. Cox Co., Boston.							
Paragon,	W. E. Bryant & Co.	Brockton	10.33	10.50	8.97	7.50	4.58
Wirthmore,	W. J. Meek	Fall River	10.39	9.50	8.83	7.50	4.21
Wirthmore,	T. Jacobsen	N. Dartmouth	10.75	9.50	9.94	7.50	
Wirthmore,	Warner Bros.	Sunderland	10.20	9.50	7.50	7.50	3.93
Wirthmore,	C. H. Mead & Co.	W. Acton	10.16	9.50	7.63	7.50	4.46
Davis Mlg. Co., St. Joseph, Mo.							
	A. T. Butler & Co.	Adams	10.62	11.00	7.60	7.70	
	Thorne Bros.	Millis	10.72	11.00	8.29	7.70	
Des Moines Corn Milling Co., Des Moines, Iowa.							
	Hobart Mills	E. Braintree	11.28	8.50	9.10	7.00	
	No. Adams Grain Co.	N. Adams	10.82	8.50	7.54	7.00	3.37
Deutsch & Sickert, Milwaukee, Wis.							
	A. Dodge & Sons	Beverly	9.89	11.00	8.05	7.00	9.30
Success,	Blood Bros.	Medfield	10.24	11.00	8.74	7.00	5.19
Success,	H. Houghton	Millbury	9.85	11.00	6.36	7.00	4.41
Success,	Morse Bros.	Southbridge	11.21	11.00	8.21	7.00	4.71
Evans Mlg. Co., Indianapolis, Ind.							
Evans',	J. Shea	Lawrence	10.79	10.00	9.75	8.00	—
Evans',	F. A. Fales & Co.	Norwood	10.38	10.00	9.72	8.00	4.85
R. J. Hardy & Sons, Boston.							
	Bosworth & Wood	Leominster	11.43	10.00	7.92	7.50	4.34
Hunter Bros. Mlg. Co., St. Louis, Mo.							
	N. Paquin & Sons	Fall River	10.23	8.50	8.05	7.00	
	J. Cushing & Co.	Hudson	10.71	8.50	8.29	7.00	
Hunter-Robinson-Wenz Mlg. Co., St. Louis, Mo.							
Capital,	B. W. Brown	Concord	10.40	11.02	6.42	7.78	4.94
Capital,	Dodge Mill Co.	Saundersville	10.62	11.02	7.99	7.78	—
Capital,	J. B. Garland & Son	Worcester	10.26	11.02	7.13	7.78	4.00
Husted Mlg. Co., Buffalo, N. Y.							
Yellow,	H. C. Bowen & Son	Cheshire	9.90	9.00	7.61	6.00	—
Yellow,	A. M. Haggart	Franklin	9.48	9.00	6.43	6.00	2.54
W. H. Haskell & Co., Toledo, Ohio.							
	F. Gauvin, Jr.	Marlboro	10.27	10.25	8.18	8.10	—
H. E. McEachron Co., Wausau, Wis.							
	E. A. Cole	Housatonic	10.16	11.25	8.06	8.50	
Miner-Hillard Mlg. Co., Wilkesbarre, Pa.							
	E. & A. M. Fullerton	Brockton	10.42	10.00	9.40	7.50	4.58
	J. A. Bouvier	New Bedford	10.48	10.00	9.16	7.50	4.08
	H. C. Puffer Co.	Springfield	10.07	10.00	7.56	7.50	
	E. A. Cowee	Worcester	10.18	10.00	7.68	7.50	
Mystic Mlg. Co., Sioux City, Iowa.							
	C. G. Burnham	Holyoke	10.36	12.00	7.26	8.00	
	Cutler Co.	N. Wilbraham	10.07	12.00	7.25	8.00	
	Cutler Grain Co.	S. Framingham	10.47	12.00	7.88	8.00	3.22
Patent Cereals Co., Geneva, N. Y.							
	C. P. Washburn	Middleboro	10.10	10.00	8.18	7.00	3.35
	W. N. Potter Grain Co.	Princeton	10.32	10.00	8.28	7.00	
Quaker Oats Co., Chicago, Ill.							
	Howe Bros.	Gardner	10.55	9.50	8.10	7.00	4.00
J. E. Soper Co., Boston.							
Blue Ribbon,	Knight Grain Co.	Newburyport	10.29	10.00	7.06	8.00	3.65
Blue Ribbon,	Taunton Grain Co.	Taunton	10.58	10.00	8.26	8.00	
Blue Ribbon,	C. E. Terry	W. Springfield	9.83	10.00	7.20	8.00	3.74

HOMINY MEAL—(Continued)

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Standard Cereal Co., Chillicothe, Ohio.							
Standco,	D. B. Hodgkins Sons	Gloucester	10.27	11.50	9.32	8.00	—
Standco,	Haverhill Mlg. Co.	Haverhill	11 32	11.50	10.26	8.00	—
Standco,	J. B. Garland & Son	Worcester	11.08	11.50	8.48	8.00	2 34
Suffern, Hunt & Co., Decatur, Ill.							
	W. E. Bryant & Co.	Brockton	10.01	9.30	8.49	7.10	—
Acme,	F. Knight	Charlton	11.12	7.10	9.01	9.30	4.90
Acme,	Springfield Flour&Gr. Co.	Springfield	10.73	9.30	8.68	7.10	—
Acme,	J. D. Norton	Warren	10.44	9.30	8.50	7.10	—
Toledo Elevator Co., Toledo, Ohio.							
*Star,	W. E. Bryant & Co.	Brockton	8.36	7.00	5.88	5.50	11.44
*Star,	Mackenzie & Winslow	Fall River	8.84	7.00	6.10	5.50	9.97
*Star,	A. Paquin & Sons	Fall River	8.86	7.00	8.04	5.50	10.40
*Star,	F. Diehl	Wellesley	8.95	7.00	6.56	5.50	10.09
	Highest		11.43	—	10.26	—	9.38
	Lowest		9.48	—	5.55	—	2.34
	Average		10.40	—	8.03	—	4.17

*Contains ground corn cob, not included in average.

PROVENDER.

Definition. Provender is a mixture of straight corn and oats ground together.

Ground by Retailer.							
	E. J. Adams	Gt. Barrington	9.54	—	4.16		4.13
	U. S. Adams	Townsend	11.84	—	4.58	—	7.31
	M. E. Ballou	Becket	8.71	—	3.55	—	2.58
	C. S. Barber	Bernardston	7.88	—	3.54	—	3.08
	H. C. Bowen & Sons	Cheshire	9.11	—	4.26	—	4 81
	E. A. Briggs Co.	Attleboro	9.92	10.00	3.52	3.50	4.00
	E. A. Cole	Housatonic	8.84	—	2.81	—	4.73
	F. G. Cover	Lowell	10.51	—	4.49	—	3.87
Corn, oat and barley,	J. O. Dean & Co.	S. Easton	10.62	—	3.12	—	3.00
	Dodge Mill Co.	Saundersville	9.81	—	4.13	—	4.43
	Dodge Mill Co.	Saundersville	9.97	—	4.04	—	3.33
	P. W. Eaton & Co.	Williamstown	8.95	—	3.27	—	5.99
	H. W. Hill & Co.	Williamsburg	8.69	—	3.22	—	7.50
	H. Houghton	Millbury	10.68	—	3.90	—	3.09
	J. F. Hunt	Lynn	10.03	—	4.77	—	4.45
	Marlboro Grain Co.	Marlboro	10.81	—	4.54	—	6.71
	Morse Bros.	Southbridge	10.44	—	4.19	—	4.60
	H. O. Parker	Pepperell	9.98	—	4.78	—	4.00
	Peterson Coal & Gr. Co.	Gt. Barrington	10.42	—	4.36	—	4.02
	Potter Grain Co.	Shelburne Falls	9.63	—	3.50	—	2.91
	Prentis, Brooks & Co.	Easthampton	8.63	—	3.59	—	3.53
	M. G. Williams	Taunton	9.54	—	3.96	—	3.33
	M. G. Williams	Raynham	9.25	—	4.07	—	3.53
	H. K. Webster Co.	Lawrence	10.20	—	4.39	—	5.03
	F. F. Woodward & Co.	Fitchburg	11.86	—	4.41	—	5.29
E. A. Cowee, Worcester, Mass.							
	I. J. Rowell	Pepperell	10.24	8.00	4.23	4.00	4.24
E. Crosby & Co., Brattleboro, Vt.							
	W. N. Flynt & Son	Monson	10.34	—	3.93	—	4.10
Cutler Grain Co., N. Wilbraham.							
	Cutler Grain Co.	S. Framingham	9.77	—	4 13	—	4 04
Husted Mlg. & Elevator Co., Buffalo, N. Y.							
	A. M. Haggart	Franklin	8.30	—	5.34	—	4.69
1-2 and 1-2,	W. A. Dunham	Ashley Falls	9.99	9.00	4.93	3.00	3.79
1-2 and 1-2,	J. E. Camp & Sons	Caryville	10.53	—	4 49	—	5.25
1-2 and 1-2,	R. W. Davies	Greenfield	9.33	—	3.63	—	5.20

PROVENDER —(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Imperial Grain & Mlg. Co., Toledo, Ohio.						
Imperial, ... C. G. Burnham	Holyoke	8.82	10.00	4.13	4.50	2.02
Imperial, ... H. K. Webster Co.	Lawrence	9.30	10.00	4.01	5.25	2.32
Imperial, ... W. Baylies	New Bedford	9.25	10.00	4.47	4.50	2.70
Imperial, ... F. W. Dorr & Co.	Newton Center	9.50	10.00	4.09	4.00	3.10
Imperial, ... E. A. Cowee	Worcester	9.00	10.00	3.22	5.25	2.78
Narragansett Mlg. Co., E. Providence.						
Taunton Grain Co.	Taunton	9.23	9.00	3.33	3.00	6.09
W. N. Potter & Sons, Greenfield.						
A. D. Potter	Orange	9.02		3.53		2.04
Smith, Northam & Co., Inc., Hartford, Conn.						
J. F. Ray	Franklin	10.23	9.00	4.21	4.00	4.27
J. F. Ray	Franklin	9.19	9.00	4.17	4.00	3.34
Stratton & Co., Concord, N. H.						
I. J. Rowell	E. Pepperell	9.97		2.00		4.34
Highest		11.86		4.93		7.50
Lowest		7.88		2.81		2.50
Average		9.71		3.07		4.14

CORN AND OAT FEEDS.

Definition. Corn and oat feeds are proprietary mixtures consisting largely of oat by-products and corn, containing less than 12 per cent protein, and usually from 8 to 15 per cent of fiber.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Amendt Mlg. Co., Monroe, Mich.						
Amco, ... Rollstone Grain Co.	Fitchburg	9.58	9.10	4.04	3.32	8.41
American Hominy Co., New York.						
Hexagon, ... D. H. Craig	Plymouth	7.90	6.00	6.06	5.00	13.73
Valor, ... Scott Grain Co.	Amesbury	7.46	6.00	2.97	2.50	12.15
A. H. Brown & Bros., Boston.						
Queen, ... Weld & Beck	Southbridge	9.83	10.00	7.17	4.00	8.66
Queen, ... Weld & Beck	Southbridge	10.79	10.00	7.03	4.00	7.79
Buffalo Cereal Co., Buffalo.						
Chop, ... G. W. Reynolds & Son	Chelsea	7.36	7.00	3.73	3.00	12.14
Chop, ... Chamberlain & Barnes	Sturbridge	7.90	7.00	3.81	3.00	12.30
Horse, ... Griffin Bros.	Fall River	11.55	10.00	5.02	4.00	9.87
Horse, ... Griffin Bros.	Fall River	11.26	10.00	4.34	4.00	8.46
Stock, ... W. Baylies	New Bedford	7.90	8.00	3.81	4.00	7.35
Stock, ... G. R. Drake	W. Bridgewater	9.21	8.00	6.44	4.00	8.73
Burbeck & Brett, N. Abington.						
All Right, ... Burbeck & Brett	N. Abington	9.26	9.00	7.13	4.00	9.10
C. M. Cox Co., Boston.						
Charlestock, ... E. & A. M. Fullerton	Brockton	7.50	6.00	4.24	3.00	15.15
Wirthmore, ... Eastern Grain Co.	Bridgewater	10.66	9.00	6.01	4.00	7.74
Wirthmore, ... Eastern Grain Co.	Bridgewater	11.12	9.00	6.13	4.00	7.33
Wirthmore, ... Prentiss, Brooks & Co.	Holyoke	10.57	9.00	4.01	4.00	8.25
J. Cushing & Co., Hudson.						
Hudson, ... J. Cushing & Co.	Hudson	9.91	10.00	6.33	4.00	7.73
F. W. Dorr & Co., Newton Center.						
Matchless, ... F. W. Dorr & Co.	Newton Center	10.73	10.00	7.25	4.00	8.33
Matchless, ... F. W. Dorr & Co.	Newton Center	9.81	10.00	7.78	4.00	7.31
Empire Mills, Olean, N. Y.						
Empire, ... J. A. Bouvier	New Bedford	9.11	7.63	3.85	3.07	5.73
Empire, ... J. A. Bouvier	New Bedford	8.50	7.50	3.75	3.00	6.00

CORN AND OAT FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
J. B. Garland & Son, Worcester.							
Red Tag A,	H. Houghton	Millbury	10.36	12.00	4.65	3.50	13.99
Red Tag A,	H. Houghton	Millbury	11.20	12.00	5.67	3.50	11.11
Red Tag A,	J. B. Garland & Son	Worcester	10.73	12.00	5.50	3.50	11.10
Red Tag A,	J. B. Garland & Son	Worcester	10.90	7.00	4.37	3.00	12.19
Red Tag B,	J. B. Garland & Son	Worcester	9.56	10.00	4.75	3.25	14.26
Red Tag B,	J. B. Garland & Son	Worcester	10.38	7.00	5.00	3.00	12.90
Red Tag B,	Brown Bros.	Northbridge	10.49	10.00	4.79	3.25	14.57
Red Tag B,	Brown Bros.	Northbridge	9.46	10.00	4.35	3.25	14.58
Great Western Cereal Co., Chicago, Ill.							
Boss,	Harry Bullukian	Franklin	8.41	8.00	3.44	3.00	9.33
Boss,	G. F. Wetherbee Est.	Gardner	9.34	8.00	5.29	3.50	6.77
Boss,	W. Baylies	New Bedford	8.64	8.00	3.62	3.50	8.82
Boss,	Springfield Flour & Gr. Co.	Springfield	8.95	8.00	4.83	3.50	11.05
Sterling,	I. J. Rowell	E. Pepperell	8.91	10.00	3.14	4.00	11.99
Sterling,	E. A. Cowee	Jefferson	9.81	10.00	6.65	4.00	9.21
Sterling,	Bowen & Fuller	Leominster	9.43	10.00	5.17	4.00	11.37
Sterling,	Dennison Plummer & Co.	New Bedford	10.79	10.00	4.18	4.00	10.82
Sterling,	Springfield Flour & Gr. Co.	Springfield	11.49	10.00	5.61	4.00	10.77
Green River Grain Co., Greenfield.							
O. K. Horse,	W. N. Potter & Sons.	Greenfield	11.54	12.00	4.33	4.25	4.31
W. H. Haskell & Co., Toledo, Ohio.							
Haskell's,	Bliss & Co.	Taunton	8.98	8.00	7.24	4.00	6.89
Haskell's,	G. Milot & Son	Taunton	10.27	8.00	7.34	4.00	7.18
Haskell's,	F. Gauvin, Jr.	Marlboro	9.30	8.00	7.66	4.00	8.63
Haskell's,	Milford Grain Co.	Milford	9.97	8.00	7.86	4.00	7.89
H. O. Mills, Buffalo, N. Y.							
Algrane Horse,	Green Coal Co.	Campello	11.91	12.00	3.14	4.50	9.27
Algrane Horse,	Lenox Coal Co.	Lenoxdale	11.08	12.00	3.39	4.50	9.90
Algrane Horse,	S. L. Davenport & Son	N. Grafton	11.23	12.00	4.08	4.50	11.28
Algrane Horse,	A. M. Reed	Westport	10.20	12.00	4.56	4.50	9.04
De Fi,	F. F. Woodward & Co.	Fitchburg	8.65	8.00	3.45	3.00	15.10
De Fi,	F. F. Woodward & Co.	Fitchburg	8.80	8.00	3.11	3.00	13.60
De Fi,	Knight Grain Co.	Newburyport	8.88	8.30	3.27	3.00	11.88
De Fi,	Bliss & Co.	Taunton	9.23	8.30	3.25	3.00	11.13
N. E. Stock,	F. F. Woodward & Co.	Fitchburg	8.45	9.00	5.94	4.00	16.19
N. E. Stock,	Knight Grain Co.	Newburyport	8.32	9.00	5.55	4.00	14.57
Husted Mlg. Co., Buffalo, N. Y.							
Eclipse,	W. A. Dunham	Ashley Falls	11.76	9.00	6.16	4.00	5.42
Husted Stock,	F. Dianto	Randolph	11.40	8.00	5.88	4.00	6.11
Husted Horse,	W. K. Gilmore & Sons	Walpole	8.99	12.00	4.14	4.00	7.59
Mayflower,	B. W. Brown	Concord	10.68	7.50	5.66	3.50	6.60
Mayflower,	A. J. Lane Co.	Springfield	8.93	7.50	4.86	3.50	6.98
Monarch,	A. J. Lane Co.	Springfield	8.45	7.50	4.48	3.50	7.13
Monarch,	A. Milot & Son	Taunton	9.11	7.50	5.21	3.50	5.66
Imperial Grain & Mlg. Co., Toledo, Ohio.							
Corn, oats and barley,	C. G. Burnham	Holyoke	8.41	6.90	3.48	3.75	12.90
Corn, oats and barley,	H. K. Webster Co.	Lawrence	9.21	8.90	3.44	3.70	11.57
Henry Jennings, Boston.							
Puritan,	J. Franks	New Bedford	9.74	8.00	7.31	3.00	6.37
Malden Grain Co., Malden.							
Excel (XL),	Malden Grain Co.	Malden	10.55	10.00	2.78	3.00	7.34
Excel (XL),	Malden Grain Co.	Malden	9.46	10.00	3.68	3.00	4.54
Meech & Stoddard, Middletown, Ct.							
Korn Oato,	A. Milot & Son	Taunton	5.92	7.00	1.95	3.00	14.91
Mollett Grain Co., Frankfort, Ind.							
Park City,	W. Baylies	New Bedford	9.48	8.00	6.88	3.50	6.13

CORN AND OAT FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
Noyes & Colby, Boston.							
New Era,	Rollstone Grain Co.	Fitchburg	9 72	10 00	3 30	4 00	8 87
Quaker Oats Co., Chicago, Ill.							
Schumacher,	A. B. Miner	Chicopee	11 25	10 00	3 34	3 50	9 07
Schumacher,	J. Enwright & Son	Fall River	10 07	10.00	3 35	3 50	9 54
Schumacher,	E. J. Adams	Great Barrington	10 81	10 00	4 51	3 50	9 47
Schumacher,	Dennison, Plummer & Co.	New Bedford	11 58	10 00	3 01	4 00	9 40
Schumacher Special,	Wallace Grain Co.	Clinton	9 32	9 25	3 48	3 25	7 00
Schumacher Special,	J. Shine	Dedham	9 56	9 25	3 30	3 25	6 20
Victor,	Phillips Bates & Co.	Hanover	8 20	7 50	3 00	3 00	12 00
Victor,	Curley Bros.	Wakefield	8 32	7 50	3 65	3 00	4 45
G. H. Reed, So. Acton.							
Acton's Best,	G. H. Reed	S. Acton	10 22	10.00	8 03	4 00	6 00
Reed's,	G. H. Reed	S. Acton	9 07	8 00	5 13	4 50	13 21
Toledo Elevator Co., Toledo, Ohio.							
Hexagon,	J. H. Nye	Brockton	8 42	6 00	5 47	5 00	13 45
Hexagon,	A. N. Whittemore	Worcester	8.62	6.00	4 73	5 00	13 76
Toledo,	H. Shaeter	Brockton	10 86	9 00	3 93	5 00	7 98
Toledo,	G. Methe & Sons	Springfield	11 54	9.00	4 06	5 00	12 55
Valor,	H. Shaeter	Brockton	7 00	5.00	2 67	50	12 84
David Stott, Detroit, Mich.							
Winner,	Rollstone Grain Co.	Fitchburg	9.00	8.00	5 79	4 00	7 42
Otto Weiss Alfalfa Stock Food Co., Wichita, Kan.							
Otto Weiss,	Loham Bros.	Marblehead	11.84	12 00	3 06	3 50	11 70
Whitney Coal & Grain Co., N. Adams.							
Best,	Whitney Coal & Gr. Co.	N. Adams	9.76	10 00	6 27	4 00	7 39
Best,	Whitney Coal & Gr. Co.	N. Adams	9 98	10 00	7 57	4 00	7 70
F. F. Woodward & Co., Fitchburg.							
Very Best,	F. F. Woodward & Co.	Fitchburg	9 21	10 00	6 77	4 00	8 79
Very Best,	F. F. Woodward & Co.	Fitchburg	9 72	10.00	7 85	4 00	8 09
Woodlock & Brennan Co., Chelsea.							
Horse,	Woodlock & Brennan Co.	Chelsea	7.14	6.00	3.90	3 00	15 90

FORTIFIED STARCHY FEEDS.

Definition. Fortified starchy feeds are corn and oat feeds to which has been added one or more protein feeds in order to bring the protein content of the mixture to between 12 and 15 per cent

American Hominy Co., New York.							
Hexagon Dairy,	Scott Grain Co.	Amesbury	15.07	12 00	3.39	4.00	13 50
Hexagon Dairy,	J. A. Bouvier	New Bedford	13.33	12 00	4.16	4 00	14 79
June Pasture,	C. W. Bowker Co.	Worcester	14.78	12 00	3.96	4 00	12 23
Buffalo Cereal Co., Buffalo, N. Y.							
Dairy,	W. T. McLaughlin & Co.	W. Roxbury	13.35	12 00	3.80	3 00	9 44
J. Burkhardt, Beverly.							
Colonial	J. Burkhardt	Beverly	13.49	12 00	5 14	5 00	7 36
Colonial,	J. Burkhardt,	Beverly	13 40	12 00	6.44	6 00	7 75
Green River Grain Co., Greenfield.							
O. K. Horse,	W. N. Potter & Sons	Greenfield	12 52	12 00	4 41	4 25	6 73
H. O. Mills, Buffalo, N. Y.							
Algrane Horse,	W. T. McLaughlin	W. Roxbury	12 20	12 00	4 15	4 50	10 72
Husted Mlg. Co., Buffalo, N. Y.							
Husted Horse,	A. J. Richards & Son	Quincy	13 04	12 00	5 36	4 00	6 86

FORTIFIED STARCHY FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Lexington Grain Co., Lexington.							
Stock,	Lexington Grain Co.	Lexington	13.42	8.50	5.43	3.50	7.52
Horse,	Lexington Grain Co.	Lexington	11.99	11.00	6.09	3.00	7.40
Alfalfa Horse,	Lexington Grain Co.	Lexington	12.43	11.00	6.07	3.00	9.02
Ralston-Purina Co., St. Louis, Mo.							
Purina Mule,	A. A. Putney & Sons	E. Brookfield	12.55	12.50	4.84	4.00	9.53
Purina Mule,	C. W. Bowker Co.	Worcester	12.08	12.50	3.92	4.00	9.18

OAT FEED.

Definition. Oat feed is a by-product of the oat kernel obtained in the manufacture of cereal breakfast food from oats. It is largely oat hulls

C. M. Cox Co., Boston.							
O. M. F.,	W. J. Meek	Fall River	5.26	5.50	2.45	2.50	26.60
O. M. F.,	Whitney Coal & Gr. Co.	N. Adams	5.75	6.00	2.57	2.00	26.51
O. M. F.,	Whitney Coal & Gr. Co.	N. Adams	6.97	6.00	3.12	2.00	23.53
O. M. F.,	G. H. Reed	W. Acton	5.73	5.75	2.58	2.50	26.02
O. M. F..	J. B. Garland & Son.	Worcester	6.53	5.50	2.78	2.50	25.47

CORN BRAN.

Definition. Corn bran is the outer hull of the corn kernel.

Glen Mills Cereal Co., Rowley.							
Coarse,	Glen Mills Cereal Co.	Rowley	7.67	9.00	3.71	4.00	12.00
Intermediate,	Glen Mills Cereal Co.	Rowley	10.46	9.00	6.49	4.00	6.47
Fine,	Glen Mills Cereal Co.	Rowley	7.92	9.00	4.59	4.00	11.80
	Glen Mills Cereal Co.	Rowley	10.79	9.00	7.26	4.00	7.69
W. N. Potter Grain Co., Gardner.							
	W. N. Potter Grain Co.	Princeton Depot	5.52	—	1.23	—	14.67

DRIED BEET PULP.

Definition. Dried beet pulp is the dried sugar beet residue obtained in the manufacture of beet sugar. Dried molasses beet pulp contains in addition to the dried pulp more or less waste molasses.

Empire Beet Sugar Co., Lyons, N. Y.							
Molasses beet pulp,	Griffin Bros.	Fall River	12.11	8.00	.34	.50	13.42
Molasses beet pulp,	Hingham Gr. Mill, Inc.	Hingham	12.13	8.00	.30	.50	8.42
Molasses beet pulp,	J. B. Garland & Sons	Worcester	11.91	8.00	.28	.50	9.78
Larrowe Mlg. Co., Detroit, Mich.							
	F. H. Whitaker	E. Longmeadow	9.24	8.00	.56	.50	17.73
	Mansfield Mlg. Co.	Mansfield	9.19	8.00	.44	.50	18.42
	Taunton Grain Co.	Taunton	9.21	8.00	1.05	.50	18.82
	Taunton Grain Co.	Taunton	8.60	8.00	1.10	.50	21.72
Michigan Sugar Co., Caro, Mich.							
	Bryant & Soule	Middleboro	8.86	8.00	.88	.40	18.45
St. Louis Sugar Co., St. Louis, Mich.							
	A. Rotch	Dighton	9.52	8.00	.46	.50	18.11

MISCELLANEOUS STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
Glen Mills Cereal Co., Rowley.						
Corn Middlings, ...Glen Mills Cereal Co.	Rowley	10 34	12 00	6 06	12 00	2 0[illegible]
A. H. Brown & Bros., Boston.						
*Dried Grains, ...Lexington Grain Co.	Lexington	15 36	10 00	3 16	2 50	16 07
*Dried Grains, . .H. A. Crossman ..	Needham	11 53	10 00	3 43	2 50	15 05
*Dried Grains, ..H. A. Crossman ..	Needham	11 76	10 00	2 66	2 50	15 14
A. R. Eales, Boston.						
Molassine Fdg. Meal, A. Culver Co.	Rockland	9 13	7 00	.66	05	5 09
Husted Mlg. Co., Buffalo, N. Y.						
**Germaline, ...A. Dodge & Sons Corp.	Beverly ..	9 27	9 00	5 12	3 50	2 20
**Germaline, ...A. Dodge & Sons Corp.	Beverly...	9.54	9 00	6 10	3 00	2 77
**Germaline, ...W. G. Horton	Ipswich ..	8 60	9 00	4 36	3 00	1 74
***Mol. Corn Flakes, ...A. M. Haggart	Franklin ..	8.90	5 00	5 21	4 00	7 33
***Mol. Corn Flakes, ...P. Foisy	New Bedford ...	9 39	7 00	6 51	5 00	6 96

*By-product from the manufacture of Mellen's Food.
**Corn meal and molasses.
***Corn bran and molasses.

III. POULTRY FEEDS.

MEAT SCRAPS.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
First Grade (over 45 per cent Protein).							
American Agric. Chem. Co., New York.							
	Phillips, Bates & Co.	Hanover	51.05	40 00	13.65	6.00	22.31
Burlington Rendering Co., Burlington, Vt.							
	N. Hatfield Grain Co.	N. Hatfield	49 56	40 00	10.31	8.00	27 95
Butchers Rendering Co., Fall River.							
Special,	W. J. Meek	Fall River	62.03	60.00	12 64	10.00	14 71
Bowker Fert. Co., Boston.							
	Mansfield Milling Co.	Mansfield	56.59	40.00	13 75	5 00	13 05
Geo. E. Marsh Co., Lynn.							
	M. G. Williams	Raynham	53.72	45.00	14 54	10 00	21 77
New England Dressed Meat & Wool Co., Boston.							
	Thorne Bros.	Millis	52.82	53.00	12.95	10 00	21.98
	H. W. Hill & Co.	Williamsburg	47.23	53.00	13.31	10.00	30 28
Park & Pollard Co., Boston.							
Blue Ribbon,	Green Coal Co.	Campello	57.01	60.00	20.03	10.00	12.14
Blue Ribbon,	A. Culver Co.	Rockland	71.99	70.00	10.51	10.00	7.61
Red Ribbon,	Cutler Co.	N. Wilbraham	72.96	50.00	11 92	10 00	6 50
Pawtucket Rendering Co., Pawtucket, R. I.							
	Taunton Grain Co.	Taunton	46.81	40.00	10.75	9.00	31.88
Portland Rendering Co., Portland, Me.							
	Scott Grain Co.	Amesbury	46.94	40.00	12 32	8.00	31.09
Richmond Abattoir, Richmond, Va.							
Rava,	Lexington Grain Co.	Lexington	88.41	85.00	7.42	7.00	3.61
M. L. Schoemaker, Phila., Pa.							
	C. Parkinson	Seekonk	61.37	55.00	11.42	10.00	13 12
	C. Parkinson	Seekonk	57.75	55 00	14 58	10 00	15.13
Springfield Rendering Co., Springfield.							
	Smith Feed Co.	Westfield	46.05	40 00	12 05	8 00	28.99
Swift's Lowell Fert. Co., Boston.							
	W. J. Meek	Fall River	46.10	40 00	10 43	8 00	28 19
J. A. Torrey, Rockland.							
No. 1,	A. Culver Co.	Rockland	45 54	46 00	17.20	19 00	24 02
H. K. Webster Co., Lawrence.							
	H. K. Webster Co.	Lawrence	57.53	55 00	15.30	12 00	20.00
	H. K. Webster Co.	Lawrence	45 77	55 00	14 14	12 00	30 06
Worcester Rendering Co., Auburn.							
	J. W. Doon & Son	Natick	52 15	40.00	11.70	8 00	25.03
	Average		54 26	—	12.90	—	21 02

MEAT SCRAPS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
Second Grade (below 45 per cent Protein).						
Andrews & Spelman Co., Providence, R. I.						
Anchor, ... H. L. Patrick	Hopedale	30.02	40.00	12.03	3.00	30.32
Star, ... Dresser, Hull Co.	Lee . .	37.47	25.00	15.00	5.00	30.35
Jos. Breck & Sons, Boston.						
J. Shine.	Dedham	44.04	43.00	17.47	12.00	20.06
Burlington Rendering Co., Burlington, Vt.						
F. E. Smith . .	Amherst	42.73	40.00	3.23	3.00	30.60
Butchers Rendering Co., Fall River.						
Bliss & Co.	Taunton	42.35	40.00	3.43	3.00	34.31
John C. Dow Co., Boston.						
G. R. Drake	W. Bridgewater	30.04	40.00	10.23	12.00	23.74
L. T. Frisbie Co., New Haven, Conn.						
Red Mills Feed Co.	Ashley Falls	35.73	40.00	13.57	3.00	39.30
Greene Chicken Feed Co., Marblehead.						
Greene Chicken Feed Co. .	Marblehead	32.02	30.00	17.22	20.00	32.10
W. D. Higgins, S. Framingham.						
E. C. Packard	Brockton	40.94	40.00	15.39	10.00	34.02
Lowell Rendering Co., Lowell.						
Peerless, ... Highland Mills .	Newton Highlands	43.40	40.00	12.73	8.00	32.62
Peerless, ... U. S. Adams . .	Townsend . .	40.66	40.00	11.40	3.00	35.36
S. A. Meager Co., Milton.						
F. H. Crane & Sons .	Quincy Adams	44.13	40.00	15.72	15.00	32.13
Park & Pollard Co., Boston.						
J. F. Ray	Franklin .	42.56	35.00	16.63	15.00	23.02
Springfield Rendering Co., Springfield.						
Springfield Flour & Gr. Co.	Springfield	37.02	40.00	11.16	3.00	33.23
J. A. Torrey, Rockland.						
No. 1, A. Culver Co.	Rockland	41.29	40.00	10.79	15.00	25.47
No. 2, A. Culver Co.	Rockland	37.51	44.00	13.41	10.00	32.22
Average		40.00		14.13		33.44

MEAT AND BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
American Agric. Chem. Co., Boston.						
Bradley's, ... E. A. Fuller & Co.	Belchertown	42.53	30.00	3.31	3.00	20.31
Armour Fertilizer Works, Chicago.						
W. F. Fillmore	Palmer	52.73	42.00	12.07	8.00	23.41
Bowker Fertilizer Co., Boston.						
A. D. Potter	Orange	37.07	40.00	10.70	3.00	30.30
Butcher's Rendering Co., Fall River.						
Griffin Bros. .	Fall River	33.33	35.00	12.72	3.00	34.37
John C. Dow Co., Boston.						
Favorite Poultry Meal, Greene Coal Co.	Campello	20.07	32.00	3.00	10.00	42.10
Hinckley Rendering Co., Somerville.						
E. O. Parker	Stoughton	30.41	35.00	3.07	3.00	33.25
Springfield Rendering Co., Springfield.						
Prentiss, Brooks & Co. . .	Easthampton	30.43	35.00	0.72	3.00	40.33
Swift's Lowell Fertilizer Co., Boston.						
O. B. Crane .	Avon	30.16	35.00	11.37	3.00	30.04

MEAT AND BONE MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
Worcester Rendering Co., Auburn.							
	Bosworth & Wood	Leominster	45.31	40.00	15.90	8.00	31.71
	Average		40.33	—	11.16	—	35.20

BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
Beach Soap Co., Lawrence.							
	Knight Grain Co.	Newburyport	9.19	10.00	9.00	8.00	73.68
Swift's Lowell Fertilizer Co., Lowell.							
	A. E. Lawrence & Son	Ayer	25.66	20.00	3.57	5.00	59.32
A. L. Warren, Northborough.							
Cracked Bone,	Bosworth & Wood	Leominster	26.81	26.00	4.03	3.00	59.39
Bone Meal,	Thorne Bros.	Millis	25.05	20.00	11.97	6.00	49.59

MILK PRODUCTS.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
Geo. L. Harding, Binghampton, N. Y.							
Uncle Sam Gran. Milk,	N. E. Poultry Supply Co.	Springfield	30.83	45.00	.67	7.00	20.39

POULTRY MASH AND MEAL.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
Local Mixtures.							
	Burbeck & Brett	N. Abington	17.27	—	4.46	—	7.95
	J. Burkhardt	Beverly	17.12	—	6.74	—	—
	E. A. Cowee	Worcester	19.96	16.00	4.02	4.00	—
Eureka,	H. A. Crossman Co.	Needham	20.70	20.00	5.62	5.00	—
	R. W. Davies	Greenfield	21.92	26.28	4.47	4.60	8.32
	R. W. Davies	Greenfield	22.07	26.28	5.99	4.60	—
	J. O. Dean & Co.	S. Easton	21.02	—	4.48	—	—
O. K.,	C. H. Felker & Co.	Brockton	15.27	11.88	4.46	4.89	3.50
	S. B. Green & Co.	Watertown	22.72	—	6.50	—	—
	S. B. Green & Co.	Watertown	20.93	20.00	6.27	5.00	—
	Greene Chicken Feed Co.	Marblehead	11.06	11.00	3.27	3.00	13.00
	Lexington Grain Co.	Lexington	22.66	18.00	3.83	3.50	11.41
	Lexington Grain Co.	Lexington	22.82	18.00	4.26	3.50	—
Complete,	Malden Grain Co.	Malden	14.97	15.00	4.56	3.50	8.65
Meat Mash,	Malden Grain Co.	Malden	13.45	15.00	4.68	3.50	—
Quality Developing,	N. E. Poultry Supply Co.	Springfield	10.82		3.03	—	—
Quality Laying,	N. E. Poultry Supply Co.	Springfield	11.17	12.50	3.02	4.00	—
Quality Mash,	N. E. Poultry Supply Co.	Springfield	12.13	16.00	4.45	5.00	—
Poultry Hash,	Ropes Bros.	Salem	19.05	18.00	4.53	4.00	—
	Thorne Bros.	Millis	20.44	—	7.20	—	12.19
Very Best,	F. F. Woodward & Co.	Fitchburg	13.25	11.00	4.35	3.00	3.58
Very Best,	F. F. Woodward & Co.	Fitchburg	14.17	11.00	3.95	3.00	—
Buffalo Cereal Co., Buffalo, N. Y.							
	Griffin Bros.	Fall River	16.71	15.00	5.13	4.00	3.20
E. A. Cowee, Worcester.							
Dry Mash,	I. J. Rowell	Pepperell	16.14	20.00	4.93	3.50	5.74
	I. J. Rowell	Pepperell	13.74	19.00	4.16	4.00	—
Growing Feed,	I. J. Rowell	Pepperell	15.41	12.00	5.00	4.00	—
Chas. M. Cox Co., Boston.							
Wirthmore Growing,	A. Culver Co.	Rockland	12.99	15.00	6.34	5.00	3.98
Wirthmore Growing,	C. O. Parmenter	S. Sudbury	12.10	15.00	3.19	5.00	—
Wirthmore Growing,	Bliss & Co.	Taunton	10.95	15.00	3.54	5.00	—
Wirthmore,	Prentiss, Brooks & Co.	Easthampton	15.49	12.00	3.94	3.00	4.16
Wirthmore,	W. J. Meek	Fall River	15.21	12.00	3.31	3.00	—
Wirthmore,	A. Culver Co.	Rockland	14.87	12.00	4.07	3.00	—
Wirthmore,	C. O. Parmenter & Co.	S. Sudbury	14.19	12.00	4.34	3.00	—
Wirthmore,	Bliss & Co.	Taunton	14.09	12.00	4.10	3.00	3.79
Wirthmore,	Whitman Gr. & Coal Co.	Whitman	13.32	12.00	4.39	3.00	3.73

POULTRY MASH AND MEAL (Continued).

Manufacturer or Jobber Brand	and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fib.
Cyphers Incubator Co., Buffalo, N. Y.							
Laying Mash,	Knight Grain Co.	Newburyport	15 92		2 56		3 45
Albert Dickinson Co., Chicago, Ill.							
Queen,	J. F. Ray	Franklin	9 35	11 00	3 05	2 50	2 00
Queen,	J. F. Ray	Franklin	9 28	11 00	2 39	2 50	-
R. B. Eaton Grain & Feed Co., Norwich, N. Y.							
Perfection,	Prentiss, Brooks & Co.	Easthampton	23 73	20 00	3 54	4 00	10 44
Greene Chicken Feed Co., Marblehead.							
Fish Mash,	J. O. Ellison & Co.	Haverhill	12 08	11 00	2 89	3 00	
Fish Mash,	Knight Grain Co.	Newburyport	11 95	11 00	2 62	3 00	
Green River Grain Co., Greenfield.							
	W. N. Potter & Sons	Greenfield	16.31		4 16		3 30
	Potter Bros. & Co.	N. Adams	16 37	16 46	4 25	4 14	3 01
	W. N. Potter Grain Co.	Princeton Depot	15.02	16 46	3 80	4 14	—
H. O. Mills, Buffalo, N. Y.							
	W. E. Bryant & Co.	Brockton	18 56	17 00	5 13	5 50	3.00
	Green Coal Co.	Campello	16 46	17 00	4 37	5 50	—
	S. L. Davenport & Son	N. Grafton	18 56	17 00	4.30	5 50	3 61
	Lamb Bros. Co.	Orange	16 11	17.00	4 65	5.50	—
Park & Pollard Co., Boston.							
Dry Mash,	Hathaway & McKenzie Gr. Co.	New Bedford	20 09	20.00	3 35	3 00	12 10
Fattening Feed,	Hathaway & McKenzie Gr. Co.	New Bedford	11 17	10 00	2 83	3 00	2 60
Growing Feed,	Hathaway & McKenzie Gr. Co	New Bedford	17 20	14 00	4 42	3 50	10.11
Purina Mills, St. Louis, Mo.							
Chowder Mash,	Mansfield Mlg. Co.	Mansfield	17 04	16 00	2 81	2 50	10 49
Quaker Oats Co., Chicago, Ill.							
American,	Bowen & Fuller	Leominster	13 97	12 00	6 27	3 50	
American,	A. M. Reed	Westport	11 83	12 00	4 59	3 50	
Ross Bros., Worcester.							
Every Morning,	I. J. Rowell	E. Pepperell	19 27	12 00	5 34	3.50	6 53
G. T. Savage Poultry Supply Co., Boston.							
Meat Cereal,	Bedford Coal & Grain Co.	Bedford	12 90	11 50	4 35	3 50	3 47
Growing & Forcing,	Bedford Coal & Grain Co.	Bedford	11 67	11 50	4 67	3 50	4 07
Shredded Wheat Co., Niagara Falls, N. Y.							
Shredded Wheat Waste,	F. A. Fales	Norwood	12 07	10 00	1 36	1 50	

CHICK AND SCRATCHING GRAINS.

Manufacturer or Jobber Brand	and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fib.
Chick.							
Buffalo Cereal Co., Buffalo, N. Y.							
	Griffin Bros.	Fall River	12 57	12 50	2 63	2 00	
	G. R. Drake	W. Bridgewater	13 04	12 50	3 00	2 00	
E. W. Conklin & Son, Binghamton, N. Y.							
Arrow,	H. W. Hill & Co.	Williamsburg	12 60	11 50	3 13	4 30	
E. Crosby & Co., Brattleboro, Vt.							
	R. W. Davies	Greenfield	10 37	11 00	1 76	3 00	
Albert Dickinson Co., Chicago, Ill.							
Crescent (D),	J. F. Ray	Franklin	10 44	10 50	3 40	3 00	7 20
Thos. W. Emerson Co., Boston.							
Gem,	C. G. Jordan	Weymouth	10 37	9 50	2 04	4 50	

CHICK AND SCRATCHING GRAINS—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Ash.
			Found.	Guar.	Found.	Guar.	
Green River Grain Co., Greenfield.							
	W. N. Potter & Sons	Greenfield	11.49	—	3.90	—	—
	W. N. Potter Grain Co.	Princeton	11.10	11.00	3.66	3.50	—
	H. W. Hill & Co.	Williamsburg	11.06	11.00	4.06	3.50	—
Husted Mlg. Co., Buffalo, N. Y.							
	W. L. Palmer	Medway	11.25	12.00	2.94	4.00	—
Miner-Hillard Mlg. Co., Wilkesbarre, Pa.							
	Dennison Plummer Co.	New Bedford	9.65	—	2.74	—	—
Park & Pollard Co., Boston.							
Gritless,	Hathaway & McKenzie Gr. Co.	New Bedford	10.46	13.76	2.24	2.77	—
Gritless,	Hathaway & McKenzie Gr. Co.	New Bedford	13.20	13.77	3.28	2.77	—
H. C. Puffer Co., Springfield.							
Fancy Gritless,	D. W. Foskett	Brimfield	11.18	10.00	2.40	3.00	—
Puritan Chick Food Co., Boundbrook, N. J.							
Puritan,	Marlboro Grain Co.	Marlboro	13.44	12.50	5.91	7.50	8.65
Quaker Oats Co., Chicago, Ill.							
Schumacher,	I. Morton & Co.	Plymouth	9.72	10.00	2.94	2.50	—
Schumacher,	Dresser-Hull Co.	Lee	10.86	10.50	2.94	3.50	—
M. H. Rolfe Est., Newburyport.							
	M. H. Rolfe Est.	Newburyport	11.37	12.50	4.03	4.00	—
Ross Bros. Co., Worcester.							
Wyandotte,	I. J. Rowell	E. Pepperell	9.65	8.25	2.55	2.25	16.10
Wyandotte,	Brown Bros.	Northbridge	10.14	8.25	3.58	2.25	—
G. F. Savage Poultry Supply Co., Boston.							
	H. A. Crossman Co.	Needham	10.77	9.50	2.31	4.50	—
F. F. Woodward & Co., Fitchburg.							
Very Best,	F. F. Woodward & Co.	Fitchburg	11.16	11.00	3.42	3.00	—
Scratching Grains.							
Local Mixtures.							
Barley,	L. A. Snow	Upton	11.97	—	1.77	—	—
Buckwheat,	Cutler Co.	N. Wilbraham	11.63	—	2.55	—	—
Kaffir corn,	Geo. Methe & Sons	Springfield	10.95	—	3.09	—	—
Wheat,	Cutler Co.	N. Wilbraham	12.00	—	1.89	—	—
Wheat,	Prentiss, Brooks & Co.	Easthampton	10.33	—	1.61	—	—
Climax,	E. A. Cowee	Worcester	10.51	10.00	5.28	3.00	—
Climax,	E. A. Cowee	Worcester	10.11	10.00	3.08	3.00	—
	F. H. Crane & Sons	Quincy Adams	10.20	—	3.07	—	—
	W. H. Cunningham	Malden	11.99	10.00	3.39	2.00	—
King,	Cutler Co.	N Wilbraham	10.58	10.00	3.09	3.00	—
King,	Cutler Co.	S. Framingham	11.21	10.00	3.22	3.00	—
	J. O. Dean & Co.	S. Easton	11.53	—	3.17	—	—
Blended Grains,	C. H. Felker & Co.	Brockton	10.71	—	3.35	—	—
	Greene Chicken Feed Co.	Marblehead	11.99	10.00	3.58	2.00	—
	Greene Chicken Feed Co.	Marblehead	12.77	10.00	4.70	2.00	—
	Hingham Grain Mill, Inc.	Hingham	10.94	15.00	4.42	3.00	—
	Hingham Grain Mill, Inc.	Hingham	10.11	15.00	4.19	3.00	—
Quality Pigeon,	N. E. Poultry Supply Co.	Springfield	12.32	12.00	3.70	3.50	—
	E. C. Packard	Brockton	12.02	—	2.78	—	—
	H. C. Puffer Co.	Springfield	11.41	—	3.02	—	—
Mixed Grains,	Ropes Bros.	Salem	11.82	10.00	2.96	2.00	—
Mixed Grains,	Ropes Bros.	Salem	11.67	10.00	2.75	2.00	—
Scratching Grains,	Ropes Bros.	Salem	11.60	12.00	3.63	4.00	—
Scratching Grains,	Ropes Bros.	Salem	11.52	12.00	3.15	4.00	—
	C. B. Sawin & Son	Southboro	11.42	—	3.27	—	—
	Springfield Flour&Gr. Co.	Springfield	11.32	11.00	2.39	3.00	—
	H. K. Webster Co.	Lawrence	11.38	10.00	3.12	3.00	—
	H. K. Webster Co.	Lawrence	11.28	10.00	3.22	3.00	—

CHICK AND SCRATCHING GRAINS (Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
Very Best,	F. F. Woodward & Co.	Fitchburg	11 06	11 00	2 05	3 00	—
Very Best,	F. F. Woodward & Co.	Fitchburg	11 17	—	3 13	—	
Ballard & Ballard Co., Louisville, Ky.							
Wheat Screenings,	W. G. Horton	Ipswich	9 50	12 50	2 50	3 00	
Bemmels Mfg. Co., Lisbon, N. Dakota.							
Wheat Screenings,	C. B. Sampson	Holyoke	15 29		5 15		
Buffalo Cereal Co., Buffalo, N. Y.							
	Griffin Bros.	Fall River	11 32		4 22	—	
	Griffin Bros.	Fall River	11 17	10 00	3 16	3 00	
E. W. Conklin & Son, Binghamton, N. Y.							
Arrow,	M. F. Fillmore	Palmer	11 08	11 45	3.40	3 35	
E. A. Cowee, Worcester.							
Crescent,	C. P. McLanathan	Barre Plains	10 77	10 00	3 45	3 00	
Chas. M. Cox Co., Boston.							
Wirthmore,	Prentiss, Brooks & Co.	Easthampton	10 67	10 00	3 31	3 00	—
Wirthmore,	Prentiss, Brooks & Co.	Easthampton	11 21	10.00	2 87	3 00	—
Wirthmore,	W. J. Meek	Fall River	11 60	10.00	2 96	3.00	—
Wirthmore,	C. T. Wyman	Hubbardston	11 03	10 00	2 88	3 00	
Wirthmore,	J. Morton & Co.	Plymouth	11 53	10.00	3 25	3 00	
E. Crosby & Co., Brattleboro, Vt.							
	R. W. Davies	Greenfield	11 21	10 00	3 25	3 00	—
	N. Hatfield Grain Co.	N. Hatfield	11 27	10 00	2 93	3 00	
Cyphers Incubator Co., Buffalo, N. Y.							
Pigeon,	S. B. Greene & Co.	Watertown	13 10	10 59	3 29	3 57	
Albert Dickinson Co., Chicago, Ill.							
Globe,	J. F. Ray	Franklin	12 33	10 50	2.95	3 00	—
Globe,	J. F. Ray	Franklin	11.95	10 00	2 92	2 50	
J. B. Garland & Son, Worcester.							
Royal Worcester,	H. Houghton	Millbury	11 69	8 00	3 65	2 00	
Green River Grain Co., Greenfield.							
O. K.,	A. D. Potter	Orange	10 82	10 00	3 58	3 00	
B. S. No. 2,	W. N. Potter & Sons,	Greenfield	10 44	10 00	3 81	3 50	
H. O. Co., Buffalo, N. Y.							
Algrane,	Lamb Bros. & Co.	Orange	12 04	11 00	3 06	3 50	
	A. M. Reed	Westport	11 61	11 00	3 30	3 50	
Husted Milling & Elevator Co., Buffalo, N. Y.							
Competition,	A. M. Haggart	Franklin	10.59	12.00	2 76	4 00	
Competition,	A. Dodge & Sons Corp.	Manchester	10 94	12 00	3 53	4 00	
North West Mills Co., Winona, Minn.							
Sugarota,	F. W. Dorr & Co.	Newton Center	10 33	12 00	3 60	3.50	
Park & Pollard Co., Boston.							
Intermediate,	Hathaway & McKenzie Gr. Co.	New Bedford	10 44	10 00	3 20	3 00	
Pigeon,	Hathaway & McKenzie Gr. Co.	New Bedford	12 33	—	3 60	—	
H. C. Puffer Co., Springfield.							
Fancy Gritless,	A. D. Thomas	Palmer	11 22	—	3 13		
Purina Mills, St. Louis, Mo.							
Purina,	Mackenzie & Winslow	Fall River	11 03	11 00	3 10	3 60	
Quaker Oats Co., Chicago, Ill.							
Hulled Oats,	M. H. Rolfe Est.	Newburyport	10 44		6 20		
Sleepy Eye Milling Co., Sleepy Eye, Minn.							
Sleepy Eye,	G. M. Foster	Lowell	11 73	—	2 77		—

CHICK AND SCRATCHING GRAINS—(Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Fiber.
			Found.	Guar.	Found.	Guar.	
F. F. Woodward & Co., Fitchburg.							
Very Best,	Taunton Teaming Co.	Taunton	11 29	11 00	3 23	3.00	—

CLOVER AND ALFALFA MEALS

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber.
Cyphers Incubator Co., Buffalo, N. Y.							
Cut Alfalfa,	W. P. Barney	Seekonk	20 16	17 60	2 59	4.00	16.33
Albert Dickinson Co., Chicago, Ill.							
Alfalfa,	Phillips, Bates & Co.	Hanover	14 33	12 00	1 55	1 00	27.94
Thos. W. Emerson & Co., Boston.							
Cut Clover,	Bosworth & Wood	Leominster	9 91	12 00	2 15	2.00	23 26
Great Western Cereal Co., Chicago, Ill.							
Alfalfa,	Goding Bros.	N. Easton	15 55	12 00	1 23	2.00	23 30
Gorvin Flour & Grain Co., Wichita, Kansas.							
Alfalfa,	Taunton Grain Co.	Taunton	12 07	16.00	1 70	2 02	34 34
Kornfalfa Feed Milling Co., Kansas City, Mo.							
Pioneer Alfalfa,	S. L. Davenport & Son	N. Grafton	15 36	15 00	1.61	2 00	23 42
Pioneer Alfalfa,	Dennison Plummer & Co.	New Bedford	16.41	-	2 04	-	23 65
Purina Mills, St. Louis, Mo.							
Alfalfa,	F. Diehl	Wellesley	14 39	-	1 56	—	28.41
Quaker Oats Co., Chicago, Ill.							
Alfalfa,	Thorne Bros.	Millis	13 66	14 00	1 96	2 00	26 98
Russell Grain Co., Kansas City, Mo.							
Square Deal,	H. K. Webster Co.	Lawrence	17 36	14 00	2 07	2 00	19.70
Square Deal,	Brown Bros.	Northbridge	18 83	14 00	2.35	2 00	20 17
Square Deal,	J. B. Garland & Son	Worcester	19.42	14 00	2 72	2 00	17.55

DISCUSSION OF THE INSPECTION.

Average Analyses and Retail Prices.

Cottonseed Meal. Pages 8-9.	High Grades (Choice).	Medium Grades (Prime and Good).	High and Medium Grades.
	1908.	1908.	1908.
No. Samples,	31	10	41
Protein (per cent),	43.07	38.19	42.12
Fat (per cent),	9.27	8.41	8.94
Price a ton,	$32.18	$32.20	$32.19
	1909.	1909.	1909.
No. Samples,	32	21	53
Protein (per cent),	42.62	39.49	41.38
Fat (per cent),	8.60	8.23	8.46
Price a ton,	$34.12	$32.55	$33.48
	1910.	1910.	1910.
No. Samples,	23	25	48
Protein (per cent),	42.35	39.14	41.51
Fat (per cent),	7.96	8.07	8.02
Price a ton,	$37.43	$38.21	$37.32

Owing to the poor cotton crop of 1909, cottonseed meal has proved for the past season to be both scarce and high, the price in many cases exceeding that ever before asked for this product. The 1910 crop is much better and prices are ruling about the same as for 1908. According to the classification of the Interstate Cotton Crushers' Association, cottonseed meal is divided into three grades, (a) *choice* containing at least 41 per cent protein, (b) *prime* containing a minimum 38.50 per cent protein, and (c) *good* containing at least 36.00 per cent protein. Quite often crushers attempt to grade their product too high. "Prime" meal is found offered as "choice" and "good" meal offered as "prime." Such a practice is misleading and shippers are cautioned against it.

It is the general practice of cottonseed crushers to pack their meal by gross weight instead of net. That is, a 100 pound sack of cottonseed meal will weigh 100 pounds, including meal and sack. This is a direct violation of the Massachusetts statute and the fact that a few crushers tag their sacks as weighing 100

pounds gross does not render them any less liable to prosecution.

At present prices, cottonseed meal furnishes a valuable and economical source of protein in the dairy ration. Consumers, when purchasing, should note carefully the *guarantee*, *weight of goods*, and *general appearance* of the meal. When any reasonable doubt exists in the mind of the buyer as to the quality of the goods, he should correspond with the experiment station and if deemed necessary the station will give instructions for taking and shipping a representative sample for analysis.

Low grade cottonseed meal or feed consists of the cottonseed hull and kernel or meat ground together. Three samples of this material were found on the market. While it was as represented and sold at somewhat lower figures than the high grade meal, one sample at least was found in a vicinity where a large foreign element is engaged in farming and a tag printed in English was of no value in furnishing them information in regard to the material which they were purchasing. This low grade article does not have over 60 per cent of the value of a high grade meal when used as a fertilizer and not over 70 per cent when used for feeding. Low grade meals are usually *very expensive*.

Linseed Meal.
Page 10.

Average Analyses and Retail Prices.

New Process.

	1907.	1908.	1909.	1910.
No. Samples,	7	6	5	5
Protein (per cent),	35.89	35.09	37.35	37.96
Fat (per cent),	3.16	3.28	3.37	2.50
Price a ton,	$32.67	$33.50	$36.00	$37.80

Old Process.

	1907.	1908.	1909.	1910.
No. Samples,	12	9	11	17
Protein (per cent),	35.27	34.94	35.89	35.96
Fat (per cent),	7.71	6.73	6.22	6.10
Price a ton,	$34.64	$35.44	$36.81	$40.65

New process linseed meal is the by-product resulting from the use of a fat solvent in extracting the oil from ground flaxseed. With old process meal the extraction is accomplished by means of heat and pressure. New process meal contains more protein and

less fat than that obtained in the old process method. Linseed meal is very seldom adulterated, contains a high percentage of protein and if it were not for the high price asked in comparison with other concentrates, would form a very satisfactory source of protein in formulating rations. Two of the samples put out by the Guy G. Major Co. ran considerably lower in protein than the average, while the price asked was equal to that for the better grade goods. One of these samples contained an appreciable amount of screenings.

Gluten Feed.
Pages 10-11.

Average Analyses and Retail Prices.

	1908.		1909.		1910.	
	First Grade.	Second Grade.	First Grade.	Second Grade.	First Grade.	Second Grade.
No. Samples,	46	31	50	5	33	6
Protein (per cent),	25.52	21.22	26.52	21.83	25.22	20.91
Fat (per cent),	2.83	3.04	2.81	4.63	3.17	6.00
Fiber (per cent),	—	—	—	—	5.92	7.53
Price a ton,	$32.48	$32.66	$32.68	$32.00	$31.88	$33.33

Gluten feeds as reported, are divided into two groups. Those which contain above 23 per cent protein are placed in the first group, while those having a less percentage are placed in the second group. With one exception the gluten feeds found on the market were free from adulteration. The sample of Royal Gluten Feed had a musty disagreeable taste and contained an excessive amount of fiber, presumably due to the addition of ground corn cob. This feed is no longer on the market.

Reports of adulteration of gluten and the statement that this material is not as good as formerly, are in no way substantiated by our investigations. It is our belief that gluten feed continues to be one of the more economical protein concentrates. Gluten feed is a corn by-product and its use as the source of protein in a ration containing home-grown corn is hardly to be advised. It may be employed, however, where corn meal is not a predominant component of the ration.

The average analysis of the six samples of second grade gluten feed showed a fat content considerably in excess of the average of the first grade samples. They also sold at a higher price. With the exception of the sample of Royal Gluten Feed the difference

in analysis was not due to the addition of foreign material but to a different process of manufacture in which the starch and germ were not so completely separated from the corn gluten and bran.

Distillers' Dried Grains. *Average Analyses and Retail Prices.*
Page 11-12.

	1907.	1908.	1909.	1910.
No. Samples,	27	17	18	14
Protein (per cent),	31.03	30.21	30.54	29.67
Fat (per cent),	12.35	8.25	11.69	11.16
Fiber (per cent),	--	--	—	12.24
Price a ton,	$30.72	$32.89	$34.00	$33.73

Distillers' dried grains vary widely in composition, the variation depending largely upon the cereal from which they are derived. For this reason purchasers should always note the guarantee before purchasing. Corn distillers' grains are the best and contain from 29-35 per cent protein. The fiber in corn distillers' grains is more digestible than that found in distillers' grains derived from other cereals. Distillers' grains are deficient in starch and for this reason can be best utilized when mixed with some feeding stuff relatively rich in that ingredient. Wheat flour middlings are excellent for this purpose, a mixture of 75 lbs. flour middlings and 100 lbs. distillers' grains forming a very satisfactory ration.

The two samples of Dearborn distillers' grains averaged 23.40 per cent protein. They cannot be considered as valuable for feeding purposes as those grains containing a higher percentage.

Rye Grains. The two samples of rye grains collected, showed an average analysis of 13.65 per cent protein, 6.14 per cent fat and 15.53 per cent fiber. Pound for pound they cannot be considered as valuable as bran. The statement has been made by reputable commission men that the rye grains can be bought at the present time at about two-thirds the price of bran. If such is the case, they can be considered as an economical substitute for bran to be used in giving bulk to a ration.

Malt Sprouts and Dried Brewers' Grains. Page 12.

Malt Sprouts.

Average Analyses and Retail Prices.

	1907.	1908.	1909.	1910.
No. Samples,	13	9	13	8
Protein (per cent),	25.94	27.61	26.88	26.72
Fat (per cent),	1.20	0.89	1.08	1.01
Fiber (per cent),	—	—	—	12.58
Price a ton,	$23.56	$26.75	$27.67	$27.81

Brewers' Grains.

	1909.	1910.
No. Samples,	5	2
Protein (per cent),	26.86	30.35
Fat (per cent),	7.09	6.81
Fiber (per cent),	—	12.95
Price a ton,	$29.75	$30.00

Malt sprouts and brewers' dried grains were not found generally distributed. They are satisfactory protein concentrates when sold at about the price of wheat bran, for which they can be substituted if the price warrants it. On account of the lack of palatability they are best used in rations consisting largely of feeding stuffs that are more highly relished. When sprouts are fed in any considerable amount (more than 2 lbs. daily), they should be moistened before feeding. Malt sprouts and brewers' dried grains are used extensively as a component of molasses and other proprietary feeds.

Wheat By-Products. Pages 13-17.

Average Analyses and Retail Prices.

Wheat Middlings, Flour.

	1907.	1908.	1909.	1910.
No. Samples,	16	28	20	18
Protein (per cent),	17.62	17.16	16.98	18.82
Fat (per cent),	4.76	4.69	4.87	5.12
Price a ton,	$30.39	$32.80	$33.56	$33.45

Wheat Middlings, Standard.

	1907.	1908.	1909.	1910.
No. Samples,	28	47	43	52
Protein (per cent),	16.78	17.14	17.53	17.56
Fat (per cent),	5.30	5.09	5.29	5.20
Price a ton,	$28.50	$31.02	$30.04	$30.94

Wheat Mixed Feed.

	1907.	1908.	1909.	1910.
No. Samples,	97	133	124	163
Protein (per cent),	16.35	16.19	16.49	16.97
Fat (per cent),	4.86	4.65	4.74	4.71
Price a ton,	$28.93	$31.12	$30.17	$29.93

Wheat Bran.

	1907.	1908.	1909.	1910
No. Samples,	58	52	38	63
Protein (per cent),	15.60	15.47	15.92	16.50
Fat (per cent),	4.89	4.53	4.57	4.86
Price a ton,	$29.67	$29.40	$28.65	$28.68

Flour Middlings. An attempt to classify and group wheat by-products is at best unsatisfactory; this is especially true of middlings. While Red Dog flour is readily distinguished, there seems to be no sharp line of demarkation between flour and standard middlings. The digestibility of middlings depends to a certain extent upon the relative proportions of flour and bran present. Middlings which contain considerable flour will be more digestible than one made up largely of finely ground bran. For this reason the purchaser should not be misled by the name in purchasing this product but should make sure that it is a genuine article. A good grade of flour middlings forms an excellent source of digestible carbohydrates (starchy matter) as well as protein.

Standard Middlings as found were of good average quality. Purchasers are cautioned against purchasing standard middlings containing ground screenings. Such an admixture detracts from the value of the product. The addition of screenings can be readily detected by the color of the material; middlings thus adulterated show a large number of dark specks due to the ground weed-seed present and have a darker shade of color than the straight product.

Wheat mixed feed is a mixture of wheat bran and wheat middlings. The proportion varies with the brand but the feed should contain theoretically all of the by-products of the wheat berry in the proportions remaining after the flour has been separated. In purchasing, preference should be given to those brands which con-

tain an appreciable amount of flour. A good grade of wheat mixed feed is superior in feeding value to wheat bran and usually sells for a somewhat higher price.

Wheat bran is usually sold as spring or winter bran, depending upon the wheat from which it is made. While this distinction serves to denote its derivation, it is not believed that the feeding value between spring and winter bran differs to any extent, and for this reason no distinction is made in the classification given in this bulletin. Wheat bran is one of the commercial feeding stuffs whose true value is not shown entirely by its chemical composition. In spite of its relatively low digestibility and protein content, on account of its bulky nature, laxative effect and safe feeding qualities, it can be advantageously used as a component of most grain rations.

Adulterated Wheat Feeds. Page 18.

Under this heading are grouped wheat by-products containing admixtures of other material than that derived from the wheat berry. The one sample of Aloras middlings collected, consisted of wheat middlings and ground wheat screenings (weed-seed, chaff and shrunken wheat). It sold for about three dollars a ton less than the straight middlings.

The wheat mixed feeds adulterated with ground corn cob have been in the market for some years, and at the time the present feeding stuffs law went into effect were often sold as straight mixed feed. So far as known, these feeds at the present time when offered for sale in Massachusetts, are tagged in such a manner as to deceive no one in regard to their true composition. The price asked rules somewhat lower than that for pure wheat feeds, but not in proportion to their decreased feeding value. They are in no way recommended. *Why buy ground corn cobs?*

Dairy Feeds. Pages 18-19.

Mixed proprietary feeding stuffs consisting of several by-products and containing 15 or more per cent protein are classified in this bulletin as dairy feeds. They are usually advertised as complete grain rations for dairy stock; a statement which is not always borne out by feeding practice. A satisfactory grain ration for milch cows should be bulky, palatable and should

contain from 20-25 per cent protein and less than 10 per cent fiber.

Oil Cake Feed is an English product often sold in cake form. The price asked for the one sample collected ($40.00 per ton), was very much in excess of its feeding value.

Ubiko Horse Feed fully maintained its guarantee. It was clean and sweet, contained no inferior offal and could be considered an economical concentrate for horses.

Union Grains, according to the manufacturers' statement, contain distillers' grains, cottonseed meal, old process linseed meal, white middlings, wheat bran, hominy meal, malt sprouts and a small percentage of table salt. It is a desirable feed of its kind.

Buffalo Creamery Feed, according to attached tags, contained corn, wheat middlings, oat hulls, hominy feed, cottonseed meal and gluten feed. It maintained its guarantee and sold for from $32.00 to $33.00 a ton.

Buffalo Dairy Feed, one sample of which was collected, sold at $32.00 per ton. It could not be considered a complete dairy ration.

Unicorn Dairy Ration, according to the manufacturers' statement, contains wheat gluten, corn gluten feed, cottonseed meal, hominy meal, linseed meal, malt sprouts, and wheat bran. It is a satisfactory milk-producing feed.

Algrane Milk Feed contained too little protein and too much fiber to be considered a balanced grain ration. The components given were oat hulls, wheat middlings, cottonseed meal, oat bran, gluten feed, corn, oats and salt.

Husted Dairy Feed, one sample of which was collected, may be considered a satisfactory dairy feed.

Sugarota Milk Meal maintained its protein guarantee, but was deficient in fat. It contained altogether too large an amount of malt sprouts to be used as an exclusive dairy feed, and at the price asked it could not be considered economical.

Ropes' Horse Feed, a local product, contained only high grade material and fully met its guarantee.

Paragon Dairy Feed contained a large proportion of cottonseed meal together with other by-products.

Wirthmore Balanced Ration Feed, according to the manufacturers' statement, contained cottonseed meal, gluten feed, linseed meal, malt sprouts, distillers' grains and bran. While the combination of grains is satisfactory, the price asked is rather high.

Molasses Feeds.
Page 19.

Molasses feeds usually consist of cereal grains or their by-products, grain screenings, one or more high grade concentrates and molasses. Their relative value can be best seen by consulting the following table of average results.

Molasses Dairy Feeds.

No. Samples.	Average Price Asked.	Name of Brand.	Protein. Found. %	Protein. Guaranteed. %	Fat. Found. %	Fat. Guaranteed. %	Fiber. Found. %	Fiber. Guaranteed. %
3	$27.33	Sucrene	16.79	16.50	4.11	3.50	13.10	12.00
4	28.75	Daisy	16.04	15.00	2.63	3.00	13.59	11.00
4	29.67	Husted's	19.97	18.00	4.40	4.00	7.13	8.00
4	29.50	Badger	15.65	16.00	2.19	3.50	13.04	12.00
1	28.00	Sugarota	14.81	16.00	3.93	3.00	13.37	—
7	28.57	Quaker Dairy	16.57	16.00	3.70	3.50	15.70	12.00
3	28.00	Hammond	17.29	17.00	3.63	3.00	11.09	9.00

Molasses Horse Feeds.

No. Samples.	Average Price Asked.	Name of Brand.	Protein. Found. %	Protein. Guaranteed. %	Fat. Found. %	Fat. Guaranteed. %	Fiber. Found. %	Fiber. Guaranteed. %
2	$29.50	Sucrene	9.97	10.00	2.64	3.00	12.86	13.50
3	30.33	Sugarota	10.58	10.00	2.89	3.00	16.07	14.00

According to the manufacturers, the ingredients were as follows in the feeds named below:

Sucrene Dairy Feed. Cottonseed meal, oats, barley, grain screenings, wheat, malt sprouts, molasses and one-half per cent salt.

Daisy Dairy Feed. Oats, cottonseed meal, alfalfa meal, oat middlings, grain screenings, New Orleans molasses and a maximum of three-fourths per cent salt.

Husted Molasses Feed. Cottonseed meal, gluten feed, oat middlings, corn, oats, oil meal, molasses and three-fourths per cent salt.

Quaker Dairy Molasses Feed. Grain screenings, flax pods and stalks, oatmeal mill by-products (oat shorts, oat hulls, oat middlings), cottonseed meal and molasses.

Hammond Dairy Feed. Cottonseed meal, distillers' grains, malt sprouts, mixed broken grains, corn, wheat, oats, barley, pure cane molasses and three-tenths per cent salt.

Sugarota Horse Feed. Malt sprouts, corn, oats, flax, bran, barley, oat clipps, molasses and a small percentage of salt.

On account of the fact that these feeds are relatively low in protein and that most of them contain very noticeable amounts of low grade by-products such as oat hulls, grain screenings and flax residues, they are not to be recommended as economical dairy feed stuffs. Husted's molasses feed was somewhat superior to the other brands offered.

Rye Feeds.
Page 20.

Ten samples of rye feeds and middlings are reported. They were of good quality, uniformly free from weed-seeds and other foreign material, and contained about as much protein as the average wheat bran. They resemble standard wheat middlings in feeding value.

Average Analysis.

No. Samples,	10
Protein (per cent),	15.08
Fat (per cent),	3.06
Fiber (per cent),	4.45
Price a ton,	$29.28

Calf Meals.
Page 20.

Eleven samples of calf meal are reported. They are intended as a whole or partial milk substitute for young calves. All of these meals will undoubtedly serve as a partial milk substitute for calves intended for dairy purposes, beginning about three weeks after birth.

II. Starchy (Carbohydrate) Feeds.

Corn Meal.

Ground Grains.
Pages 21-22.

Average Analyses and Retail Prices.

	1909.	1910.	Average of 27 analyses of corn kernels.
No. Samples,	41	51	—
Protein (per cent),	8.85	8.55	9.79
Fat (per cent),	3.59	3.81	4.41
Fiber (per cent),	1.88	1.84	1.40
Price a ton,	$30.79	$29.28	—

Fifty-one samples of corn meal are reported. A fiber determination was made on practically all of the samples to determine if the cob had been ground with the meal. While no adulteration was encountered, a large number of the samples collected, particularly those put out by the larger millers, were not straight corn meal, but by-products from the manufacture of table meal and cracked corn. These by-products varied to quite an extent in composition. The partially bolted meal contained a low fiber percentage, while the meals containing a larger amount of the corn germ and bran more nearly approach hominy feed in composition. Such material should be guaranteed to conform to the Massachusetts law.

It will be seen from the preceding table that the average analysis of 27 samples of corn kernels showed a noticeably higher percentage of protein and fat than did the meal collected in the open market. The average fiber content was also lower. This fact proves either that the larger part of the meal found on the market has the better part of the kernel removed, or that New England grown corn is superior to that grown in the west. In either case the argument is in favor of using home-grown grain.

Corn meal is an excellent starchy feed, containing at least 90 per cent of digestible matter. It furnishes a larger amount of energy (power to do work) than any other cereal. Nevertheless it is not good business policy, as a rule, for the dairy farmer to purchase corn. It should be produced upon the farm and protein concentrates purchased.

Ground oats. Fourteen samples of ground oats were analyzed. They were of good quality and free from added oat hulls or other adulteration. While oats are an excellent feed for dairy animals, their usual high price makes their general use inadvisable. Ground oats form a favorite constituent of rations given pure bred animals on forced tests. As a feed for horses, it is not believed that ground oats have any particular advantage over the whole grains, when the teeth are sound and the digestion good.

Rye Meal. The four samples of rye meal examined were of good quality. Rye meal is hardly equal in feeding value to corn meal for the dairy cow. If home grown it can be best used as a

feed for hogs. It is usually economical for the farmer to sell or exchange the home-grown seed for high grade concentrates.

Hominy Meal. *Average Analyses and Retail Prices.*
Pages 22-24.

	1907.	1908.	1909.	1910.
No. Samples,	40	47	51	62
Protein (per cent),	10.71	10.20	11.21	10.29
Fat (per cent),	8.25	7.79	8.61	7.94
Fiber (per cent),	—	—	—	4.21
Price a ton,	$27.50	$31.88	$31.72	$30.13

With one exception the hominy feed collected was of excellent quality and free from adulteration. One sample of Success hominy feed contained 9.38 per cent fiber, which would indicate the addition of ground corn cob or other fibrous material. Three other samples of this same brand were of good quality. Hominy meal, feed, or chop, is a pure corn by-product usually made from white corn, although yellow hominy is occasionally found. It has substantially the same feeding value, and can be substituted for corn meal whenever the latter can be used to advantage. It contains slightly more protein and correspondingly more fiber and fat than clear corn and correspondingly less starchy matter. Hominy meal, when fed with oats, constitutes a very satisfactory ration for horses.

Star Feed is included with the hominy meals because it is composed largely of hominy with a considerable admixture of ground corn cob. While the manufacturers comply with all of the provisions of the law, it is believed that the consumer either through ignorance or design on the part of the retailer, often purchases this article for straight hominy feed.

Moral: read the guarantee before you buy!!

The four samples of Star brand collected sold at an average price of $28.50 a ton, against $30.00 for clear hominy. The difference in feeding value is greater than the difference in price would indicate.

Corn and Oat Feeds.
Pages 24-27.

Provender. The general understanding of the term provender in Massachusetts is taken to be a mixture of straight corn and oats ground together. Forty samples of provender were collected and all proved to be

free from adulteration. Imperial Steam Cooked Feed, a mixture of cracked corn and crushed oats, is included in this group. It contains rather more corn than the local ground provenders and sells at a higher price.

Corn and oat feeds contain corn or hominy meal, together with oat hulls, light oats and oat middlings. Other cereals or their by-products and alfalfa meal are occasionally present. A study of the different brands collected, shows them to vary in price from $28.00 to $33.00 a ton. They varied in protein content from about 6 to 12 per cent, in fat from about 2 to 8 per cent, and in fiber from about 5 to 16 per cent. Those brands which contain the smaller amounts of fiber (less than 10 per cent), if free from mould and rancidity, can often be profitably used in feeding horses, but cannot be recommended as satisfactory or economical for milk production. These mixtures serve as convenient receptacles for excessive amounts of oat hulls, which increase their fiber content and lower their feeding value. Corn and oat feeds usually sell at about the same price as the wheat by-products, although not equal to them in feeding value.

Fortified Starchy Feeds. **Pages 27-28.**

Fortified starchy feeds are mixtures of cereals or cereal by-products, together with a small amount of protein concentrates. They are sold either as stock or horse feeds. When free from mould and rancidity and containing less than 10 per cent fiber, they are quite suitable for horse feeds, if sold at a reasonable price. On account of their protein deficiency, they cannot be considered as satisfactory for milk production. Hexagon Dairy Feed and June Pasture Feed contained too much fiber to be considered economical for either dairy stock or horses.

Oat Feeds. **Page 28.**

Oat feed is a by-product of the breakfast food factories. It consists largely of oat hulls, together with more or less oat middlings, light oats, sweepings and chaff. It is seldom sold by itself, but is a prominent component of some molasses feeds, corn and oat feeds and fortified starchy feeds, and is occasionally found as an adulterant in provender which is sold for straight corn and oats.

Corn Bran. Page 28. In large corn milling plants, the bran is separated from the seed before the corn is finely ground. This bran is usually mixed with the germ and softer portion of kernel, the mixture being ground and sold as "B" meal. Corn bran is also a by-product of corn starch and glucose factories. At the present time, so far as known, the corn bran thus produced is ground and mixed with the gluten meal and the resulting mixture comprises gluten feed.

Corn bran is occasionally offered unmixed. The five samples reported sold for about $22.00 a ton and are considered economical if protein is not desired. The fiber of corn bran is much more digestible than that of the oat hull.

Dried Beet Pulp. Page 28. Dried beet pulp is the dried residue remaining after the extraction of the juice from the sugar beet in the manufacture of beet sugar. It may also contain considerable refuse beet molasses, in which case it is known as *dried molasses beet pulp*. This latter material contains less fiber and relatively more sugar and protein than the straight dried pulp. Beet pulp should be moistened before feeding and can be considered a satisfactory though not economical substitute for silage, roots or other succulent home-grown feeds.*

Miscellaneous Feeds. Page 29. *Corn middlings*, the product of a local mill, was much like hominy meal in composition.

Dried grains, a by-product from the manufacture of Mellen's Food, was represented by three samples. Their high fiber content is objectionable.

Molassine Feeding Meal, an English product containing a large amount of molasses, could not be considered economical at the price asked ($36.00 a ton).

Germaline consisted of corn meal and dried molasses. It should form a satisfactory source of digestible carbohydrates.

Molasses Corn Flakes consisted of corn bran and dried molasses.

Flax Shives. A material known as flax shives, while not reported in the preceding tables, is said to have been offered and sold quite extensively to dairymen in certain sections of the state

*See special article on Dried Beet Residue by Dr Lindsey in Part II of 22nd report of this station, pp. 21-26.

during the past season. A sample of this material was found to contain 5.62 per cent protein, 2.41 per cent fat and 37.77 *per cent fiber* and to consist of refuse from the flax plant (stalks, pods and leaves). Its feeding value did not exceed that of rye straw. Its retail price is not known, but it is safe to assume that it is not worth to the Massachusetts farmer, the cost of the freight from the place where it was produced.

III. Poultry Feeds.

Animal By-Products. Pages 30-32.

Meat Scraps, as reported, are divided into two groups; (a) those containing over 45 per cent and (b) less than 45 per cent protein. The difference in protein content is due largely to the amount of bone present. A good grade should be free from taint, be ground moderately coarse, and should not contain an excess of ash or fat. Meat scraps are sometimes made from diseased animals. While disease germs harbored in meat of this character are probably killed by thorough cooking, it is felt that meat scraps should be so tagged as to indicate their source. Rava Meat Meal deserves special mention, in that it is practically pure dried meat and is very rich in protein.

Meat and Bone Meals were of usual quality and varied greatly in protein content. In purchasing this material the guarantee should be carefully noted.

Granulated Milk. One sample of so-called granulated milk did not equal its guarantee in either protein or fat. The analysis does not indicate that this is either pure dried milk or skim milk as the name would indicate; it is probably a milk by-product.

Poultry Mashes and Meals. Pages 32-33.

Sixty samples of poultry mash are reported, many of which are put out by the local dealer and sold by him only to his customers. The prices ranged from $1.60 to $2.75 a hundred, the average being $2.05. Many of the mashes did not contain anything to warrant the price asked, as the same ingredients in a cattle food would not bring over $1.60 a hundred. These mixtures are usually put up and sold in small amounts, which accounts in a certain measure

for the high price. It is believed, however, that where the poultry man is able to purchase feed in 100 lbs. lots or over, it will be possible for him to save money if he will purchase the several ingredients and do the mixing himself.

Chick and Scratching Grains.
Pages 33-36.

Chick Feed consists of mixtures of grains and seed reduced to such a size as to be suitable for young chicks. The price asked ranged from $2.00 to $3.00 a hundred. While this is somewhat in excess of the price asked for many whole grains, special machinery is required to reduce and prepare the seed which necessarily adds to the cost. Unless the poultry man owns an extensive plant, it will be best for him to purchase this material when wanted, at market prices, rather than to attempt to prepare it himself. In selecting a chick feed, preference should be given to brands that do not contain grit, or an excessive amount of millet or weed-seed. Very few of the samples collected contained grit.

Sixty samples of scratch grains and whole seeds were collected. Scratch grains consist of varying proportions of corn, wheat, oats, barley, Kaffir corn, buckwheat and often sunflower seed. Other ingredients are occasionally identified; grit and oyster shells are at the present time seldom found. One sample of Greene's scratching feed contained an excessive amount of weed-seed. Most of these mixtures will probably prove satisfactory although home mixtures will prove somewhat cheaper. Where poultry is kept on the farm, home-grown grain, especially corn, should be utilized. A mixture consisting of one-half cracked corn, one-fourth wheat and one-fourth barley or oats will make a satisfactory ration.

Alfalfa and Clover Meals.
Page 36.

The alfalfa meal collected showed a wide variation in fiber content. The better grades should not contain over 25 per cent of fiber. The prices asked ranged from $1.55 to $2.50 a hundred. Finely cut rowen, home-grown clover cut in the bud and moistened with hot water, roots or cabbage will furnish vegetable matter more economically. When it is necessary to purchase, preference should be given to those brands which contain the smallest amount of fiber.

HOW A BALANCED RATION MAY BE CALCULATED.*

Given the necessary amount of home-grown roughage, a grain ration which would approximately balance or round out the ration should have the following qualifications:

1. It should be bulky, palatable and free from mould and rancidity.
2. It should contain from 20 to 25 per cent of protein.
3. It should not contain over 9 per cent of fiber.

With home-grown corn and cob meal supposing it is desired to add wheat mixed feed and cottonseed meal in order to produce a ration containing 20-25 per cent of protein and less than 9 per cent of fiber.

	Protein. %	Fiber. %
Corn and cob meal contains	8	7
Wheat bran contains	16	10
Cottonseed meal contains	41	6

(*a*) *Protein Calculation.*

250 lbs.	corn and cob meal x 8% protein	=20.0 lbs. protein.
100 "	bran x 16% protein	=16.0 " "
100 "	cottonseed meal x 41% protein	=41.0 " "
450 lbs. total,		77.0 lbs. protein.

Dividing 77 lbs. protein by 450 lbs. total weight, we get 17 per cent protein for the mixture, which does not meet our requirement.

In our trial ration we have too little protein and it will be necessary to reduce the amount of wheat bran or corn and cob meal. Reducing the corn and cob meal by 100 lbs. and the bran by 25 lbs. we have:

150 lbs.	corn and cob meal x 8% protein	=12.0 lbs. protein.
75 "	bran x 16% protein	=12.0 " "
100 "	cottonseed meal x 41% protein	=41.0 " "
325 lbs. total,		65.0 lbs. protein.

Dividing 65 lbs. total protein by 325 lbs. mixture, we have 20 per cent protein for mixture which would make approximately a balanced ration.

(*b*) *Fiber Calculation.*

150 lbs.	corn and cob meal x 7% fiber	=10.5 lbs. fiber.
75 "	bran x 10% fiber,	= 7.5 " "
100 "	cottonseed meal x 6% fiber	= 6.0 " "
325 lbs. total,		24.0 lbs. protein.

*In figuring a balanced ration by this method, it is necessary to take it for granted that if the protein supply is sufficient, the total digestible matter,—carbohydrates and fat—will take care of themselves. With all ordinary feeding stuffs this is practically true. For more scientific methods of calculating rations, see any of the standard works on feeding farm animals.

Dividing 24 lbs. total fiber by 325 lbs. mixture, we have 7 per cent fiber for mixture, which is within the limit set.

Therefore, a mixture of 150 lbs. corn and cob meal, 75 lbs. bran and 100 lbs. cottonseed meal would make a balanced ration. Where none of the fiber percentages exceed nine, the fiber content may be disregarded and the protein alone figured. Seven pounds of such a mixture is a fair average amount for cows weighing 800 to 900 lbs., which are yielding 10 qts. of milk daily. For every two quarts of milk yielded in excess of this amount, the grain ration may be increased by one pound.

Always compare and mix feeding stuffs by pounds. After a ration is mixed it is an easy matter to find the quart equivalent and in feeding the feed can be measured instead of weighed.

PROTEIN AND FIBER CONTENT OF THE MORE COMMON COMMERCIAL FEEDING STUFFS.

	Protein.	*Fiber.*
Brewers' dried grains,	24	12
Corn and cob meal,	8	7
Corn meal,	9	2
Cottonseed meal,	41	7
Distillers' dried grains,	31	12
Gluten feed,	26	7
Hominy meal or feed,	10	4
Linseed meal,	36	8
Malt sprouts,	26	12
Oats, ground,	12	8
Rye middlings,	12	3
Wheat middlings, flour,	19	3
Wheat middlings, standard,	17	7
Wheat mixed feed,	16	8
Wheat bran,	15	10

TYPES OF RATIONS.

I.

125 lbs. bran,
100 lbs. flour middlings,
100 lbs. gluten feed,
Mix and feed 6 to 8 lbs.
(7 to 9 qts.) daily.

II.

125 lbs. bran,
100 lbs. corn or hominy meal,
100 lbs. cottonseed meal,
Mix and feed 6 to 8 lbs.
(7 to 9 qts.) daily.

III.

100 lbs. wheat bran,
100 lbs. gluten feed,
35 lbs. cottonseed meal,
Mix and feed 7 lbs.
(8 to 9 qts.) daily.

IV.

125 lbs. malt sprouts,
100 lbs. corn or hominy meal,
125 lbs. gluten feed,
Mix and feed 7 lbs.
(6 1-2 to 7 qts.) daily.

V.

75 lbs. wheat bran,
150 lbs. corn and cob meal,
100 lbs. cottonseed meal,
Mix and feed 6 to 8 lbs.
or qts. daily.

VI.

150 lbs. distillers' grains,
150 lbs. standard middlings,
100 lbs. corn or hominy meal,
Mix and feed 7 lbs.
or qts. daily.

WEIGHT VS. MEASURE OF CATTLE FOODS.

This table has been prepared by weighing a carefully measured quantity of the several feeds.

Feed Stuff.	*One Quart Weighs.*	*One Pound Weighs.* Measures.
Protein Feeds.		
Cottonseed Meal,	1.5 lbs.	0.7 lbs. qts.
N. P. Linseed Meal,	0.9 "	1.1 "
O. P. Linseed Meal,	1.1 "	0.9 "
Gluten Meal,	1.7 "	0.6 "
Gluten Feed,	1.3 "	0.8 "
Germ Oil Meal,	1.4 "	0.7 "
Distillers' Dried Grains,	0.5–0.7 "	2.0–1.4 "
Malt Sprouts,	0.6 "	1.7 "
Brewers' Dried Grains,	0.6 "	1.7 "
Wheat Middlings (flour),	1.2 "	0.8 "
Wheat Middlings(standard),	0.8 "	1.3 "
Wheat Mixed Feed,	0.6 "	1.7 "
Wheat Bran,	0.5 "	2.0 "
Oat Middlings,	1.5 "	0.7 "
Rye Feed,	1.3 "	0.8 "
Starchy Feeds.		
Whole Oats,	1.0 "	1.0 "
Ground Oats,	0.7 "	1.4 "
Whole Wheat,	1.9 "	0.5 "
Ground Wheat,	1.7 "	0.6 "
Whole Barley,	1.5 "	0.7 "
Barley Meal,	1.1 "	0.9 "
Whole Rye,	1.7 "	0.6 "
Rye Meal,	1.5 "	0.7 "
Whole Corn,	1.7 "	0.6 "
Corn Meal,	1.5 "	0.7 "
Corn and Cob Meal,	1.4 "	0.7 "
Corn Bran,	0.5 "	2.0 "
Hominy Meal,	1.1 "	0.9 "
Oat Feed,	0.8 "	1.3 "

Some good books on feeding:

The Feeding of Farm Animals, Jordan, MacMillan & Co., N. Y.; Feeds and Feeding, Henry, Published by Author, Madison, Wis.; Feeding Farm Animals, Shaw, Orange Judd Co., N. Y.

MARKET PRICES OF COMMERCIAL FEED STUFFS FOR 1910.

FEED STUFFS.	Monthly Wholesale Ton Prices—1910.												Average.
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Cottonseed Meal	$35.99	$35.83	$35.20	$34.19	$33.25	$32.25	$32.00	$32.30	$32.19	$31.50	$30.90	$30.81	$33.03
Linseed Meal (N. P. and O. P.)	—	—	37.50	—	—	33.44	34.44	35.50	36.88	37.38	36.30	36.13	35.95
Gluten Feed (sacked)	32.31	33.75	32.75	29.05	28.60	27.84	—	28.30	28.09	26.10	25.71	26.13	28.97
Gluten Feed (bulk)	31.01	32.40	31.25	28.00	27.78	27.73	—	—	27.26	—	—	—	29.35
Distillers' Dried Grains	34.00	35.00	34.50	33.25	31.50	31.25	31.38	31.75	31.88	31.00	30.75	30.75	32.25
Malt Sprouts (sacked)	—	—	—	—	—	—	—	—	—	—	—	23.00	23.00
Flour Middlings (Red Dog)	32.19	32.00	30.85	28.75	29.50	29.00	30.19	29.95	29.13	29.25	28.90	28.94	29.89
Standard Middlings (shorts)	26.10	28.16	27.63	25.63	25.63	24.88	27.32	27.58	26.69	25.07	26.90	27.94	26.63
Mixed Feed	29.13	28.82	28.15	26.07	25.57	24.63	26.19	26.70	26.10	25.54	25.80	27.25	26.66
Bran, Spring	27.75	27.19	26.00	23.06	22.94	22.25	24.13	24.05	23.19	22.13	23.70	25.44	24.32
Bran, Winter	28.44	27.69	26.60	25.06	24.19	21.31	24.19	24.25	23.63	22.94	24.00	25.69	24.83
Hominy Meal (sacked)	29.91	29.20	27.32	24.54	25.20	24.66	25.16	26.17	25.51	25.23	23.65	24.18	25.89
Hominy Meal (bulk)	28.68	28.17	25.86	23.55	24.57	23.49	24.28	25.04	24.50	23.80	—	23.18	25.01
Corn Meal	28.30	28.00	27.30	27.00	26.80	26.50	27.30	28.00	26.20	23.80	24.00	23.50	26.39
Corn, No. 2 yellow	27.20	26.28	25.70	24.81	25.88	25.17	26.24	26.60	23.85	21.56	22.13	22.96	24.87
Oats, No. 2 clipped white	34.75	35.19	32.93	31.38	31.25	29.06	31.13	28.00	25.81	24.69	24.88	25.00	29.51
Rye, No. 1	31.13	32.13	32.31	31.95	31.34	30.87	30.88	29.24	28.49	28.56	29.95	29.99	30.57
Feed Barley	30.73	31.57	30.11	26.19	25.65	26.90	28.52	29.15	29.32	29.82	31.90	32.48	29.36

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MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION.

The Rational Use of Lime.

WM. P. BROOKS.

The Distribution, Composition and Cost of Lime.

H. D. HASKINS and J. F. MERRILL.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

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AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

THE RATIONAL USE OF LIME.

WM. P. BROOKS.

No subject connected with the various steps which may be taken to increase the productive capacity of soils interests our farmers at the present time more than the use of lime. The practice of applying lime, while it has always been somewhat in vogue, has become much more general during the past few years than formerly. This change must on the whole be regarded with favor; but there is a possible danger that the pendulum may swing too far in the other direction. It is well to remember that in most parts of the state there is sufficient lime in the soil to meet the direct requirements of our growing crops. This does not mean that lime is not often highly useful; but is mentioned simply to emphasize the fact that if useful it is usually because of indirect or secondary effects and not because more lime as a source of food for the growing crop is required. The facts being as stated, it is highly important to know what these indirect or secondary effects may be.

POSSIBLE EFFECTS OF LIMING.

The secondary or indirect results which will follow an application of lime must of course vary with soil conditions, but the principal possible effects which are of importance are as follows:

1. Free acid if present is neutralized. A sour soil is sweetened.
2. Some of the less soluble potash compounds of the soil are rendered available and the need of potash manures will be lessened at least for a time. Liming will not permanently take the place of potash manuring, for it will be understood that it adds no potash to the soil. It simply makes it possible to draw upon the stock found in the soil more rapidly, and this, if persisted in without application of potash, will ultimately result in the exhaustion of this element.
3. Phosphatic fertilizers are often rendered more effective. This seems to be especially true of the less soluble materials, such as fine ground rock phosphates. An application of lime appears also to increase the availability of the comparatively inert phosphates of the soil itself.
4. Organic matter decomposes more rapidly and the plant food it contains becomes more promptly available. This action is most important in its relation to nitrogen, and it is especially valuable in heavy soils, in which organic matter naturally decays slowly. Its effect is also often important after turning under a green crop. On the other hand rapid decomposition of the or-

ganic matter, naturally present in such soils in only small amount, may prove harmful to the lighter soils.

5. Ammonia and its compounds change into nitric acid more quickly. In other words, ammonia nitrogen becomes more promptly available, as nitric acid when combined with bases which form nitrates is the most promptly available nitrogen compound for most crops. Sulfate of ammonia, when used as a fertilizer, gives poor results in many of our soils unless these are first heavily limed.

6. Lime mellows heavy and clayey soils. It does this because it flocculates the clay particles, thus making the soil more friable and permeable. Both drainage and capillary action are therefore improved and the soil is less likely to become over compact and to form crusts and to crack. The maintenance of good tilth is therefore more easy.

7. A moderate application of lime, especially if used in connection with green manuring or an application of any organic manure, will increase the capacity of the lighter soils to retain moisture.

8. Heavy applications of lime in practically all locations in the state as far as tested, appear to be absolutely necessary for success with alfalfa.

9. The presence of lime in the soil is highly unfavorable to the parasitic organisms which are the cause of certain diseases. Most important among such diseases are club-foot of cabbages and cauliflowers and finger-and-toe of turnips and beets. If the soil is badly infested lime may not prove a complete prevention, but the free use of lime without doubt decreases the tendency to these diseases.

HOW TO DETERMINE WHAT SOILS NEED LIMING.

1. Those soils on which, when seeded, timothy and clovers fail, and where sorrel comes in largely together with red top, usually need liming. It should be pointed out, however, that the presence of sorrel is not a proof that lime is needed. This weed will flourish even in soils which have been heavily limed; but on such soils the grasses and clovers are likely to crowd it out, while on soils which are in need of lime, they are unable to do so. The presence of much moss or an abundant growth of bluets (Houstonia caerulea), horse tails (Equisetum), or polypods (Polypodium) is an indication that lime will probably be beneficial.

2. When soil is sour it will turn blue litmus paper placed in contact with it red. To carry out the test, make about a tablespoonful of the soil into a thin mud with pure water and after it has stood for a short time lay a piece of blue litmus paper on it and cover with the mud. Be careful not to handle the paper

with the fingers. After about ten minutes remove the paper, washing it if necessary to show the color. If it has turned red, the soil is sour and needs an application of lime. Practically all druggists keep litmus paper.

3. The most certain evidence of all as to whether lime will prove beneficial is afforded by a simple experiment which may be carried out as follows: Lay off two square rods in a part of the field to be tested which seems to be fairly representative and even in quality. To one of these apply 20 pounds of freshly slaked lime. After applying at once work it in deeply and thoroughly. A few days later apply to each plot a liberal quantity of either manure or fertilizer, precisely the same amount to each. Plant table beets. If the soil is much in need of lime, these will make a better growth upon the limed plot.

THE RELATION OF LIME TO CROPS.

Different plants require varying amounts of lime. Some are extremely sensitive to and much injured by the presence of free acid. Others are comparatively indifferent to the presence of such acids, while still others appear to do better in soils containing them. Among plants requiring large amounts of lime in the soil are alfalfa, clovers, peas, beans and vetches. Grasses, as a rule, require less lime than clovers, but timothy will not do well in soils markedly deficient in lime. On the other hand, red top thrives in sour soils. Neither corn nor millets are especially sensitive to acid. They will often do well on soils which are sour. The same is true of potatoes; although excessive acidity is undesirable for even these crops. Cabbages and turnips and all the cultivated members of the same family require large amounts of lime. Mangel wurzels, sugar beets and table beets are usually benefited by lime, as are also onions, spinach and lettuce; celery also is much benefited by liming. Among fruits the apple, pear, peach, plum and cherry usually do best where lime is abundant. The blackberry, on the other hand, does well in soils containing free acid, and some experiments indicate that the strawberry does not particularly require lime.

Lime should not be applied immediately preceding a crop of potatoes. They are more likely to be affected with scab should such an application be made.

METHODS OF APPLYING LIME.

Although lime applied as a top dressing on grass land is often beneficial, it proves most effective in correcting most of the faults of soils needing liming if it can be applied to the plowed surface and thoroughly mixed with the soil. The autumn or early spring is usually best, but lime may be applied without hesitation at

any season of the year when the land is not occupied by crops and when it can be plowed. If manures or fertilizers containing ammonia or organic nitrogen are to be used in connection with lime the latter should be put on and incorporated with the soil before the manure or fertilizers are applied. Lime should always be applied broadcast, and as soon as possible after it is spread upon the rough furrow it should be deeply worked into the soil. For this purpose either the disk, cutaway or spring-toothed harrow will be most effective. To apply by hand is disagreeable, especially in the case of the finest and driest forms of lime. A machine distributor or a manure spreader should be used if possible, and the extent to which the lime will fly into the air when a distributor is used will be much reduced by an apron of heavy burlap attached to the bottom of the hopper and extending to the ground.

QUANTITY OF LIME NEEDED.

The amount of lime needed under different conditions varies from a few hundred pounds to several tons; but an average of about one ton of good lime to the acre will usually be sufficient. If grades of lime are used which contain 50 per cent or less of calcium oxide larger quantities will be required. Such applications as have been suggested will not unusually be called for a second time. Smaller applications—perhaps three to six hundred pounds —once in two to four years, will be preferable to very heavy applications at longer intervals; and if basic slag be freely used as a source of phosphoric acid, it is probable that a second application of lime will in most cases be unnecessary.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. LINDSEY, *Chemist.**

The Distribution, Composition and Cost of Lime.

H. D. HASKINS and J. F. MERRILL.

1. MASSACHUSETTS LIME SOURCES.

In the western part of this state there exists sufficient lime of excellent quality to supply the requirements of Massachusetts agriculture for a long time to come. Hitchcock, as early as 1835 in his Geology of Massachusetts, makes this very emphatic in the following statements:

"No part of the world is better supplied with limestone than the western part of Massachusetts. Enough exists to furnish the whole state, and I might say probably with truth, the whole of New England, through all future generations with marble and quicklime. In other parts of the state limestone is comparatively rare."

The limestone belt, belonging chiefly to what is known as the lower Silurian formation, begins at Adams on the north and extends to the south the entire length of the state. Mention may be made of large active quarries at Adams, Cheshire, Lee and West Stockbridge. Deposits have also been found in other portions of the state but so small in area or so impure in quality as not to be considered relatively of any commercial importance. The fact may be mentioned, however, that in earlier times, before the opening of the Boston and Albany railroad, the small deposits at Bernardston and Bolton were quarried, burned and used to supply the local demand.

2. PRESENT CONDITION OF TRADE IN AGRICULTURAL LIME.

The lime trade in Massachusetts is at present in a rather chaotic state. This is due largely to two causes:

(1) There are many different kinds and grades of lime offered, and dealers do not as a rule guarantee composition. Each is likely to represent the particular article he desires to sell as best,

*This portion of the bulletin was undertaken at the suggestion of Dr. J. B. Lindsey, who also co-operated with Mr. Haskins in the preparation of the results for publication. The collection of samples and data was made by Mr. Haskins and the analytical work was performed by Messrs. Haskins and Merrill.

and it is impossible by ordinary examination to discriminate between the various offerings.

(2) Few among our farmers understand the special qualities and adaptations of the different kinds of lime, and few therefore would be able to select wisely even were the composition definitely known.

The fertilizer law now before the Legislature will help remove the first of these sources of uncertainty, for under it dealers will be required to guarantee composition. This bulletin, it is hoped, will prove helpful in the diffusion of such knowledge concerning the various kinds of lime as will enable farmers to correctly estimate their relative values for different purposes.

An effort has been made to procure samples of all lime products that are being offered for sale in the Massachusetts markets and on subsequent pages will be found the composition and cost of the various products. The following states are represented: Maine, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey and Pennsylvania.

3. CHEMISTRY OF DIFFERENT FORMS OF LIME.

Lime occurs in nature as lime carbonate and in this form is widely distributed as limestone, marble, chalk and marl; also in the form of lime sulfate or gypsum. It likewise occurs as phosphate of lime in bones and mineral phosphates and as carbonate in oyster shells and wood ashes.

Limestone.—Most of the lime used in agriculture comes originally from limestone rock (calcite) or carbonate of lime ($CaCO_3$). Many limestones are composed partly of lime carbonate together with varying proportions of carbonate of magnesia ($MgCO_3$) (20 to 40 per cent). Such mixtures are termed dolomitic limestones, and their behavior is not greatly unlike the pure lime compounds. Caustic magnesia does not slake or take on water as readily as caustic lime, and there is reason to believe that it is more mild in its action in the soil. In this country, as abroad, it has frequently not met with as high favor as the high calcium limes. It is not advisable to apply magnesium limestones to soils already rich in magnesia and deficient in lime. Pure limestone or calcium carbonate contains some 56 parts of calcium oxide (CaO). Many limestones contain from 50 to 53 per cent of calcium oxide and 40 per cent and over of carbonic acid, together with varying proportions of magnesia*, iron, alumina and sand. When limestone is used on the soil it should be finely ground so that the larger part of it will pass a 75 mesh sieve; in other words, its beneficial action will depend largely upon its degree of fineness. It is easy to see a very fine limestone can be more evenly distributed and more

*High magnesium limes should not be used for spraying.

intimately mixed with the soil, thus requiring a smaller application per acre than would be the case with a coarse limestone.

Marl.—Marls are geologically confined to the Alluvial and Tertiary strata. The composition of pure marls is quite similar to limestone, the lime being present in the form of carbonate. They differ in appearance from limestone in having an amorphous or non-crystalline structure. In some of the Southern states more or less phosphoric acid is found associated with marl deposits. This very likely is due to the bones of small animals being deposited with the shells, which are in reality the source of marls. There are hardly any two marl deposits which have the same chemical composition—they contain varying quantities of earthy matter and should always be purchased upon a guaranteed analysis of calcium oxide. A deposit of considerable extent has been discovered in the vicinity of Barton, Vermont. It appears to be of good quality and should be a valuable source of lime provided it can be secured so that 100 pounds of calcium oxide compare favorably in cost with an equal amount in other lime products. Dried marls are usually in a suitable mechanical condition for direct application, and if of satisfactory quality, they are efficient sources of lime.

Quick or Burned Lime.—Chemically speaking, this material is calcium oxide (CaO). It is known also as caustic or unslaked lime. It is made by heating to a red heat in kilns either lime rock or oyster shells. Kilns are constructed so that wood, coal or gas can be used as a fuel. The heating process drives off the carbonic acid (CO_2) and the quicklime (CaO) results. This material is the most active form of lime and is not ordinarily used on the land. It will absorb moisture from the atmosphere and thus increase largely in volume. It cannot, therefore, be readily shipped in bags, and those who have used it in the ground form complain that the fine dust, settling upon the perspiring men and horses, causes serious burning and discomfort. Caustic lime can, of course, be bought in barrels or in bulk in lump form, so that 100 pounds of calcium oxide will cost less than when slaked or hydrated, or in the form of carbonate. One hundred pounds of quicklime contains as much calcium oxide as 178 1-2 pounds of carbonate of lime (ground limestone and marl), or 132 pounds of slaked or hydrated lime $Ca(OH)_2$.

Slaking Lime. Some advocate placing the lump lime in small heaps, covering with soil and allowing to slake gradually.

If a machine is available for spreading the lime it should preferably be slaked in heaps of moderate size by the gradual addition of water, using care not to apply enough to render the lime pasty or wet. The proportion of about two pailfuls of water to each 100 pounds of lime, if so applied as to wet all the lumps as

evenly as possible, will usually be sufficient. It is best to allow the heap to stand a few days when it will probably be found that the lumps have crumbled to a fine powder. If a few still remain, they may be either raked out or separated by shoveling over a sand screen. These remaining lumps may be treated with more water or allowed to lie exposed to the weather in the open air until slaked.

Water-Slaked or Hydrated Lime.—When water is added to caustic or burned lime, intense heat is evolved, due to its chemical union with the calcium oxide, calcium hydrate $Ca(OH)_2$, slaked or hydrated lime resulting. If just sufficient water is added to completely hydrate the lime, a perfectly dry, fine powder will be produced. One hundred pounds of quicklime takes substantially 32 pounds of water, resulting in 132 pounds of dry, slaked lime. This material is an active form of lime not only readily neutralizing free soil acids, but also performing all of the other desirable functions of lime in a most efficient manner. Some of the commercial slaked limes contain an excess of water, i. e., more than enough to combine with the lime. On the other hand, some samples have shown that an insufficient amount of water was used in the slaking process, quicklime still being present in the mixture.

Air-Slaked Lime.—When caustic lime is exposed to the air it absorbs moisture and carbonic acid slowly, and gradually crumbles to a fine condition. The composition of the material will vary greatly depending upon the length of exposure and other conditions. Air-slaked lime is usually classed as a more mild form of lime than either the water-slaked or caustic lime.

Lime Ashes.—This material is a mixture of ashes from the fuel used in burning lime together with small pieces of lime which fall from the kiln. Lime ashes vary in composition, depending upon the nature of the fuel used in the kiln as well as upon the length of exposure to the weather. All of the lime may be present as carbonate or, if not exposed for too long a time, some of it may be present either as slaked or in caustic form. If a good quality of wood has been used for fuel, there will be some potash and phosphoric acid present, which increases the value for agricultural purposes.

Wood Ashes.—The lime in wood ashes is largely present as carbonate. One hundred pounds of calcium oxide from this source is as valuable as the same amount from fine ground limestone, marl or lime ashes. In addition to the lime, wood ashes contain varying quantities of potash in form of carbonate, as well as some phosphoric acid and magnesia, which add to the value of the ashes as a fertilizer.

Basic Phosphatic Slag.—This material is purchased chiefly as a source of phosphoric acid, of which it contains 16 to 18 per cent, mostly in an available form, in addition to 40 to 50 per cent of lime. The exact form in which the lime is united with the phosphoric acid is unknown, but recent investigations indicate a silico phosphate of lime and ferrous oxide.[1] $(CaO)_5\ FeO\ P_2O_5\ SiO_2$. The slag gives a decidedly alkaline reaction and a portion of the combined lime is easily liberated and will probably act in the soil as a base, but because of the complexity of the lime combination it is quite impossible to state the exact percentage of basic lime. Different samples also show from 2 to 7 1-2 per cent of free lime (calcium oxide and calcium carbonate) but largely as oxide.

It would probably not be advisable to depend upon slag meal for the purpose of producing that sharp change in mechanical condition which is needed in the heavy, sour clays; but by a rather free use of slag meal many of the ordinarily looked for beneficial effects of liming may be expected to follow; and in any case, if soil has once been brought into satisfactory condition by one heavy application of lime, we may doubtless depend upon the lime in slag meal freely used as a source of phosphoric acid, to hold the soil in a satisfactory condition as regards that element.

Waste lime from tanneries can often be had for the cost of carting. It is a desirable form of lime, probably largely carbonate and hydrate. It may contain a large excess of water and not be as convenient to apply as some other forms. It may be conveniently distributed, however, by means of a manure spreader. Many samples contain considerable nitrogen, coming from hair and fleshings from the hide, which gives the material an additional value.

Waste lime from gas houses is not as desirable as that from tanneries. It is apt to contain injurious sulfites and sulfides and should be left exposed to the action of the air for some time before applying it to the land. The lime may be present in this material in several forms, such as sulfate, sulfide, sulfite, carbonate and hydrate. In many instances when in close proximity to its source, the farmer can use this material, provided it can be had at a slight expense.

Gypsum, sulfate of lime or land plaster, found in large quantities in Nova Scotia and in Onondaga County, New York, is a combination of lime and sulfuric acid. The Nova Scotia gypsum contains substantially 34 per cent of lime and 48 per cent of sulfuric acid; the Onondaga plaster 30 per cent of lime, 32.5 per cent of sulfuric acid, 8 or more per cent of carbonic acid, and rather

1. Morrison in the Journal of Agricultural Science, Vol. III, Part 2, p. 169; also Hendrick in the Journal of the Society of Chemical Industry, Vol. XXVIII, No. 14, pp. 775-778.

more insoluble matter than the Nova Scotia article. This form of lime acts particularly as a liberator of soil potash, as a distributor of plant food and as a source of sulfur for the legumes. It does not correct soil acidity but rather increases it. This latter action is explained by the fact that in liberating potash, the lime of the lime sulfate combines with the silicic acid of the soil, and the sulfuric acid thus liberated unites with soil bases, forming compounds having an acid reaction. Gypsum, therefore, should not be applied continuously to soils deficient in lime carbonate. Gypsum is likewise valuable as a stable absorbent, altho acid phosphate and kainit are considered more efficacious.

4. ANALYSIS AND COST OF LIME.

The analyses following are arranged alphabetically according to the producer's name. They represent about all of the products that are sold for agricultural purposes in the state. Some of the samples have been collected by our inspector from stock found in the general markets, others have been forwarded by persons or agents interested in the purchase or sale of lime. In most cases the samples above referred to have been taken according to instructions furnished by the station and are, therefore, representative. The greater part of the samples reported was forwarded by the producers at our request, the samples being taken so as to reppresent fairly the material in question. Calculations have been made which show the average comparative cost of 100 pounds of calcium oxide (CaO) from the various sources, delivered in car lots in bulk for cash. The cost of bagging generally adds $1.50 per ton, in some cases bags are returnable. In the magnesium limes a pound of magnesium oxide has been calculated at the same value as has calcium oxide.

CHESHIRE LIME MANUFACTURING CO., CHESHIRE, MASS.

No.I. Agricultural lime, forwarded by the producer.
No. II. Agricultural lime, forwarded by a consumer.
No. III. Agricultural lime, forwarded by a consumer.

	I.	II.	III.
Calcium oxide (CaO)	58.22	62.78	58.83
Magnesium oxide (MgO)	2.05	.63	.77
Carbonic acid (CO_2)	7.26	26.59	29.66
Iron and aluminium oxides	1.52	.26	—
Insoluble matter	.93	—	—
Uncombined moisture	13.37	—	—
Average cost, in cents, of 100 lbs. of calcium and magnesium oxides	33	32	34

NOTE.—The quotation on this material was $4.00 per ton, bulk, delivered carload lots or $4.50 per ton bagged, the consumer to furnish bags. The greater part of the lime in sample

No. I was present as slaked lime altho the excess of moisture lowers the percentage of calcium oxide to about what is shown in the other two samples. Samples Nos. II and III show in round numbers about 2-3 calcium carbonate and 1-3 calcium hydrate; 28 per cent of No. III was too coarse to pass a sieve having circular openings 1-50 of an inch in diameter.

ROBERT HARRIS, LIME ROCK, R. I.

No. I. Slaked lime, forwarded by manufacturer.

NEW ENGLAND LIME CO., DANBURY, CONN.

No. II. Burned granulated lime (Adams product), forwarded by producer.

No. III. Limestone dust (Adams product), forwarded by producer.

No. IV. Limestone dust (Adams product), forwarded by consumer.

No. V. Air-slaked lime (Canaan product), forwarded by producer.

No. VI. Limestone dust (Danbury product), forwarded by a consumer.

	I.	II.	III.	IV.	V.	VI.
Calcium oxide (CaO)	43.80	93.62	70.17	59.24	47.53	54.39
Magnesium oxide (MgO)	18.93	1.77	2.57	1.33	32.24	.87
Carbonic Acid (CO_2)	5.05	2.00	18.31	18.32	.32	35.54
Iron and aluminium oxides	1.24	1.58	1.16	—	4.48	—
Insoluble matter	2.90	1.03	1.27	—	4.00	—
Uncombined moisture	7.39	—	—	—	—	—
Cost, in cents, of 100 lbs. of calcium and magnesium oxides	62	43	32	39	35	51

NOTE.—The quotation on No.I was \$5.00 per ton, bulk, f. o. b. Lime Rock, R. I. The freight rates to various points in Massachusetts are from 11 to 15 cents per hundred. The lime in this material was present largely as slaked lime, together with a large percentage of magnesia. No. II was quoted \$6.50 per ton f. o. b. Adams, Mass., bulk, car load lots; if shipped in sacks, \$1.50 per ton extra, sacks not returnable. Nos. III and IV were quoted \$3.00 per ton, f. o. b. Adams, bulk, car load lots; \$1.50 per ton extra in sacks. The freight rates on all three samples tovarious points in Massachusetts are from 7 to 15 cents per hundred. The analysis shows sample No. II to be largely caustic lime in fine granular form suitable for distribution in a fertilizer drill. Unlimited supplies may be had. Nos. III and IV contain the greater part of their lime as carbonate together with noticeable amounts of slaked lime. The product is the fine particles of stone which are drawn out of the kiln by draught and deposited in the dust chamber at the back of the kiln. Originally they consisted of varying proportions of quick lime which has become air-slaked upon standing. Supply rather limited. No. V is a magnesium lime, the magnesium being present largely as magnesium oxide (MgO), and the lime largely as slaked lime with some (about 1-4) quicklime. Sample No. VI. is largely carbonate of lime, only 1-2 of its weight being present as slaked or hydrated lime. Samples V and VI were quoted at \$4.00 per ton f. o. b. Canaan and Danbury, Connecticut. Freight rates are from 7 to 9 1-2 cents per hundred to various points in Massachusetts.

NEW JERSEY LIME CO., HAMBURG, N. J.

No. I. Top dressing lime, forwarded by producer.

No. II. Sheldon's agricultural lime, forwarded by producer.

No. III. Sussex hydrate lime, forwarded by producer.

No. IV. Agricultural lime, forwarded by a consumer.

WM. MITCHELL, 1505 CHAPEL ST., NEW HAVEN, CONN.

No. V. Agricultural lime, forwarded by a consumer.

No. VI. Agricultural lime, forwarded by a consumer.

	I.	II.	III.	IV.	V.	VI.
Calcium oxide (CaO)	59.40	90.76	72.00	71.49	65.60	55.52
Magnesium oxide (MgO)	2.26	1.38	2.50	.86	.66	.83
Carbonic acid (CO_2)	17.20	none	.37	3.91	14.89	7.05
Iron and aluminium oxides	3.82	1.08	.88	—	—	—
Insoluble matter	7.57	1.58	.47	—	—	—
Cost, in cents, of 100 lbs. of calcium and magnesium oxides	41	39	60	35	36	36

NOTE.—No. I is composed of about equal parts of carbonate and slaked lime. It is not a finely ground material, only about 22 per cent will pass a 50 mesh sieve; the coarse portion varies from less than 1-16 of an inch up to over 1-4 of an inch in diameter. It was quoted at $2.00 per ton, car lots f. o. b. Hamburg, N. J. No. II contained about 3-4 of the lime in caustic form (CaO) and about 1-4 as carbonate; it is not fine ground but is in pieces varying from a very small size to particles 1-4 to 1-2 inch in diameter. It could not be spread by a fertilizer drill. This lime was quoted at $4.00 per ton, car lots, f. o. b. Hamburg, N. J. No. III is nearly pure slaked lime, in very fine condition, and can be distributed by fertilizer drill; quoted at $6.00 per ton, car lots, f. o. b. Hamburg, N. J. No. IV is a hydrated lime containing 7 to 8 per cent of carbonate. Price not given but $2.00 per ton, car lots, f. o. b. Hamburg, N. J. assumed. The freight rates from Hamburg to points in Hampden County are $2.80 per ton. To points reached by N. Y., N. H. & H. R. R. and Boston & Albany R. R., $3.00 to $3.50 per ton. Nos. V and VI are about 2-3 hydrated lime and 1-3 carbonate. These limes cost $4.70 and $4.00 in bulk, car lots, delivered at Pratt's Junction and East Brookfield.

OLDS & WHIPPLE, HARTFORD, CONN.

No. I. Agricultural lime, collected in Hadley, Mass.

BERKSHIRE FERTILIZER CO., BRIDGEPORT, CONN.

No. II. Marl, collected in Sunderland, Mass.

F. H. PILLSBURY, BARTON, VT.

No. III. Marl, forwarded by producer.
No. IV. Marl, forwarded by producer.

ROCKLAND-ROCKPORT LIME CO., ROCKLAND, ME.

No. V. Lump lime, forwarded by producer.
No. VI. Pine Cone hydrated lime, forwarded by producer.

	I.	II.	III.	IV.	V.	VI.
Calcium oxide (CaO)	54.83	49.23	52.10	51.83	96.80	71.96
Magnesium oxide (MgO)	13.52	—	none	—	1.27	1.45
Carbonic acid (CO_2)	5.34	—	—	—	none	1.70
Iron and aluminium oxides	—	—	.48	—	.88	1.18
Insoluble matter	—	—	1.74	1.52	.42	.13
Cost, in cents, of 100 lbs. of calcium and magnesium oxides	70	86	41	41	41	58

NOTE.—No. I is a magnesium lime in which most of the lime is present in the hydrated (water-slaked) form; cost $9.50 per ton delivered in Hadley, Mass. No. II is a fair quality of marl or lime carbonate, equivalent to 87.85 per cent carbonate of lime ($CaCO_3$); cost $8.50 per ton, delivered in Sunderland, Mass. Nos. III and IV are a good quality of marl and would be equivalent to 92 to 93 per cent calcium carbonate; this product quoted $6.00 per ton, car lots, sacks, delivered Massachusetts points, a rebate of 5 cents allowed for each sack returned in good condition; quoted in paper bags at $5.25 per ton and in bulk at $4.25 delivered at any Boston & Maine R. R. station. No. V was in lump form and would need to be slaked before application. It was of good quality, quotations not supplied for publication. No. VI is almost pure slaked lime in fine mechanical condition and if favorable quotations could be secured, would undoubtedly make a superior source of lime. Nos. V and VI are builders lime and the price of 100 pounds of calcium oxide as stated in the table approximates the cost to the trade.

ROCKLAND-ROCKPORT LIME CO., ROCKLAND, ME.

No. I. R. R. Land lime, forwarded by producer.
No. II. Hydrated lime, forwarded by a consumer.
No. III. R. R. Land lime, forwarded by a consumer.
Nos. IV, V, and VI. R. R. Land lime, forwarded by a consumer.

	I.	II.	III.	IV.	V.	VI.
Calcium oxide (CaO)	62.80	70.93	72.74	64.16	60.20	59.27
Magnesium oxide (MgO)	1.56	.94	.94	1.12	4.03	4.20
Carbonic acid (CO_2)	18.87	2.84	2.05	14.86	16.47	16.03
Iron and aluminium oxides	1.14	6.96	6.00	.58	—	1.58
Insoluble matter	1.14	—	—	—	—	2.19
Cost, in cents, of 100 lbs. of calcium and magnesium oxides	66	59	58	65	66	67

NOTE.— No. I carries over 1-2 of its lime as hydrate, the remainder being carbonate. It was fine and could be easily drilled as could the other R. R. brands. Quotation of $8.00 to $9.00 per ton, car lots, bulk, delivered Massachusetts points, the price varying with freight rates. No. II is largely slaked lime but carries a little of quicklime and carbonate. Quotation not furnished; in calculating cost of 100 pounds calcium oxide $8.50 per ton was assumed. No. III is largely slaked lime but carries also about 13 per cent of quicklime and small amount of carbonate. Nos. IV, V and VI are about 2-3 slaked lime and 1-3 carbonate. The quotations on No. I apply to these numbers and also to No. III.

VERMONT MARL CO., BRATTLEBORO, VT.

No. I. Marl, forwarded by producer.

VERMONT LIME CO., INC., GREENFIELD, MASS.

No. II. Burned lump lime, forwarded by producer.
Nos. III, IV, and VI. Agricultural lime forwarded by a consumer.
No. V. Agricultural lime, collected of consumer.

	I.	II.	III.	IV.	V.	VI.
Calcium oxide (CaO)	47.25	87.78	61.78	74.90	74.19	61.39
Magnesium oxide (MgO)	1.04	4.52	6.04	6.81	5.28	5.76
Carbonic acid (CO_2)	—	2.79	1.80	3.78	4.20	11.12
Iron and aluminium oxides	.78	3.16	—	—	—	—
Insoluble matter	7.93	1.75	—	—	—	—
Cost, in cents, of 100 lbs. of calcium and magnesium oxides	54	46	63	52	53	63

NOTE.—No. I contains all of its lime as carbonate. Quotations $3.00 per ton car lots, bulk, f.o. b. Vermont, $5.00 per ton burlap bags. Freight about $2.25 per ton to Massachusetts points, making the cost $5.25 delivered car lots bulk. No. II largely caustic lime in lump form and must be slaked. Nos. III, IV, V and VI—largely slaked limes with small quantities of carbonate, and in some cases from 10 to 20 per cent quicklime; ground and can be drilled. Quotations of $8.00 to $9.00 per ton delivered, car lots, to Massachusetts points.

CHARLES WARNER CO., 161 DEVONSHIRE ST., BOSTON, MASS.

No. I. Cedar Hollow ground limestone (55 mesh), forwarded by producer.

No. II. Cedar Hollow ground limestone (85 mesh), forwarded by producer.

No. III. Cedar Hollow lump lime (quicklime), forwarded by producer.

No. IV. Cedar Hollow ground quicklime, forwarded by producer.

No. V. Cedar Hollow limoid, forwarded by producer.

No. VI. Cedar Hollow limoid, forwarded by a consumer.

	I.	II.	III.	IV.	V.	VI.
Calcium oxide (CaO)	29.40	29.82	57.21	53.62	49.36	42.16
Magnesium oxide (MgO)	20.89	20.67	41.08	36.52	28.94	28.27
Carbonic acid (CO_2)	—	—	.17	.97	1.03	18.15
Iron and aluminium oxides	.60	.48	.80	1.64	1.76	1.44
Insoluble matter.	3.43	2.37	.76	3.08	1.35	1.32
Costs, in cents, of 100 lbs. of calcium and magnesium oxides	60	74	38	50	61	67

NOTE.—All of the products in above table are high magnesium limes. Nos. I and II are ground limestone with both lime and magnesium as carbonates, about 80 per cent of No. I passed [illegible] mesh sieve and 84 per cent of No. II passed 80 mesh sieve. No. I quoted $[illegible] and No. II $[illegible] per ton delivered in bulk car lots. No. III is quicklime-magnesia in lumps; is quoted $7.[illegible] to $8.00 per ton, delivered, bulk, car lots. No. IV practically same as No. III with the exception of being finely ground; quoted $9.00 per net ton in paper bags, delivered, car lots. No. V is a hydrated lime in very fine mechanical condition. No. VI is supposed to be the same as No. V, but contains considerable lime and magnesium as carbonate. "Limoid" has been quoted $[illegible] per net ton, car load lots, and $11.50 per single ton delivered.

CHARLES WARNER CO., 101 DEVONSHIRE ST., BOSTON, MASS.

No. I. "Limoid", forwarded by a consumer.

No. II. Berkeley ground limestone (80 mesh) forwarded by producer.

No. III. Berkeley lump lime, forwarded by producer.

No. IV. Berkeley ground lime, forwarded by producer.

No. V. Berkeley hydrated lime, forwarded by producer.

	I.	II.	III.	IV.	V.
Calcium oxide (CaO) .	46.50	51.45	95.76	88.56	72.58
Magnesium oxide (MgO) ..	30.00	1.61	none	2.93	2.28
Carbonic acid (CO_2)	1.76	—	.56	2.40	1.28
Iron and aluminium oxides .	1.16	1.88	.28	3.62	2.98
Insoluble matter...	.62	4.34	.14	1.12	.40
Cost, in cents, of 100 lbs. of calcium and magnesium oxides	62	71	39	49	63

NOTE.—No. I is a slaked magnesium lime in very fine mechanical condition; quoted $[illegible].50 per ton in car lots and $11.[illegible] per single ton, delivered. No. II is a finely ground high calcium carbonate ([illegible] per cent $CaCO_3$), [illegible] per cent passing 80 mesh sieve. Quoted $7.50 a ton bulk, delivered. No. III is a high grade quicklime in lumps. Quoted $7.00 to $8.00 per ton, delivered car lots. No. IV is the quicklime ground fine (84 per cent quicklime, a small amount slaked and in form of carbonate); quoted $[illegible] per ton, paper bags delivered car lots. No. V is a fine slaked lime containing 87 per cent hydrated lime with a little caustic or quicklime and magnesium. Quoted at $[illegible] per ton, car lots and at $11.50 per single ton delivered.

WEST STOCKBRIDGE LIME CO., WEST STOCKBRIDGE, MASS.

No. I. Screened hydrate lime, forwarded by producer.
No. II. Hydrate lime tailings, forwarded by producer.
No. III. Hydrate lime tailings, forwarded by consumer.
No. IV. Unscreened hydrate lime, forwarded by producer.
No. V. Out-of-door refuse lime, forwarded by consumer.

	I.	II.	III.	IV.	V.
Calcium oxide (CaO)	66.80	61.53	64.03	61.04	62.58
Magnesium oxide (MgO)	5.02	4.23	8.79	11.21	5.57
Carbonic acid (CO_2)	1.50	1.71	3.20	1.21	4.36
Iron and aluminium oxides	3.82	5.96	—	5.22	—
Insoluble matter	2.79	8.63	—	2.00	—
Cost, in cents, of 100 lbs. of calcium and magnesium oxides	42	30	27	35	29

NOTE.—No. I contains about 83 per cent slaked lime with few per cent caustic magnesia and carbonate of lime; it will pass a 60 mesh sieve; quoted $4.00 per ton, bulk, f. o. b., West Stockbridge. Average freight rates to Massachusetts points $2.00 per ton. Nos. II and III carry over 80 per cent slaked lime with small amount caustic magnesia and carbonate lime. It is sufficiently fine to be used in a fertilizer drill; supply said to be limited as it is the residue from the slaked lime which will not float in an air blast. Quoted $2.00 per ton, bulk, f. o. b. West Stockbridge. No. IV is unscreened slaked lime composed of about 81 per cent slaked lime and 11 per cent caustic magnesia, the whole fine enough for drilling. Quoted $[illegible] per ton, bulk, f. o. b., car lots, West Stockbridge. No. V is refuse lime that has been thrown in a pile and allowed to slake. The sample analysed contained most of its lime in slaked form with only small amount as carbonate. Quoted $2.00 per ton, bulk, f. o. b. West Stockbridge.

OTHER SOURCES OF LIME.

No. I. Lime ashes, average of 42 analyses made at this laboratory.
No. II. Wood ashes, average of 735 analyses made at this laboratory.
No. III. Waste lime from tanneries, average of 2 analyses.
No. IV. Oyster shell lime, average of 7 analyses.
No. V. Waste lime from gas houses, average of 5 analyses.
No. VI. Basic slag phosphate, average of 42 analyses.

	I.	II.	III.	IV.	V.	VI.
Calcium oxide (CaO)	44.58	32.44	54.78	45.87	48.19	44.33
Magnesium oxide (MgO)	1.30	3.31	—	—	8.30	—
Carbonic acid (CO_2)	—	—	—	20.73	—	—
Iron and aluminium oxides	—	—	—	—	—	16.18
Insoluble matter	7.24	16.52	2.83	10.08	8.99	—
Potash (K_2O)	1.77	5.13	—	—	—	—
Phosphoric acid (P_2O_5)	.70	1.51	—	—	—	15–16*
Nitrogen	—	—	.65	—	—	—
Moisture	9.10	12.67	—	—	12.	—

NOTE.—No. I. Lime ashes will vary widely in composition. At $[illegible] to $[illegible] per ton delivered, it would be questionable economy to purchase the ashes as a lime source. No. II. Wood ashes of late years vary so widely in composition and run so low in potash as to give the impression that few shipments are unleached but rather a product which has been either

leached artificially or stored carelessly so that a considerable portion of the potash has leached out. The average price of $10.50 to $12.00 per ton delivered, bulk, makes it an expensive source of either lime or potash. The following materials would give equally as good results at a cost of $8.50 per ton unmixed:

170 lbs. basic slag phosphate,
206 " high grade sulfate of potash,
900 " hydrated lime,
724 " earth.

2,000 lbs.

In practice it would be preferable to mix the 170 pounds slag and 200 pounds of potash with 1624 pounds of lime, the total materials, unmixed, costing $10.30 a ton. The mixture would yield some 500 pounds more actual lime than is contained in average wood ashes. No. III. Waste tannery lime is likely to vary considerably in composition, sometimes running as high as 40 to 50 per cent of moisture. The lime is present as hydrate and carbonate and the material may contain considerable organic matter containing nitrogen. It is too wet to be applied by drill but may be distributed readily by means of a manure spreader and makes a very good source of lime. No. IV. Oyster shells when burned and slaked or finely ground make a satisfactory source of lime. When coarsely ground and unburned, their value as a lime source is greatly reduced. If ground so as to pass an 80 mesh sieve the material would probably compare favorably with unburned finely ground limestone. No. V is a fair sample of gas house lime. Its form, value and method of treatment has already been referred to.

*Available.

SUMMARY OF PRESENT COST OF LIME IN MASSACHUSETTS MARKETS.

Average, highest and lowest cost in cents of 100 pounds of calcium and magnesium oxides.

Source.	Average.	Highest.	Lowest.
Ground limestone,	68	74	60
Marl,	55 1-2	86	41
Lump or caustic lime,	41	46	38
Ground caustic lime,	46	50	39
Slaked or hydrated lime,	56	67	35
Lime tailings or screenings,	28 1-2	30	27
Refuse lime,	29	—	—

The above table shows that it is well worth while to become familiar with the composition as well as with the cost of the different brands of lime. It is often possible to purchase lime of desirable quality for about one-half the price that is sometimes asked for another product which is very little or no better in quality.

WHAT KIND OF LIME SHALL THE FARMER BUY?

It is difficult or quite impossible to answer this question to suit the needs of each individual. In general the following brief statements may be made:

1. Quick and hydrated limes are best suited to heavy, clay soils, when it is desired to improve their mechanical condition.
2. Carbonates in the form of finely ground limestone or marls work quite satisfactorily on light loams.
3. Lime containing large percentages of magnesia should not be applied to soils deficient in carbonate of lime.

4. Calcium oxide costs the least in the form of quick or freshly burned lime but is quite disagreeable to spread.

5. Slaked or hydrated lime can be spread with less discomfort than quicklime, but costs on an average 10 cents more per 100 pounds of calcium oxide.

6. One hundred pounds of calcium oxide in the form of ground limestone costs at least 10 cents more than a like amount in the form of marl or slaked lime, and some 25 cents more than in the form of quicklime.

7. Lime is an aid to good farming but cannot take the place of fertilizers, stable manure, thorough cultivation and proper crop rotation.

BULLETIN No. 138 **JUNE, 1911**

MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION

TOMATO DISEASES

BY

GEORGE E. STONE

Diseases Induced by Parasitic Organisms

BLOSSOM END ROT

Theories in Regard to the Cause. Spraying for Tomato Rot. Investigations on the Blossom End Rot of Tomatoes. Relation of External Conditions to the Blossom End Rot. Conclusions Regarding the Blossom End Rot.

Timber Rot (Sclerotinia). Tomato Scab (Cladosporium). Sleeping Disease or Wilt (Fusarium). Downy Mildew (Phytophthora). Anthracnose (Colletotrichum). Leaf Blight (Cylindrosporium). Leaf Blight (Septoria). Leaf Mold (Alternaria). Blight (Bacillus). Eel Worms (Heterodera). Surface Mold.

Diseases Induced by Abnormal Functions

Burn or Scald. Hollow Stem. Oedema. Mosaic Disease.

Soil Conditions. General Considerations in Regard to Greenhouse Diseases. Conclusion.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

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AMHERST, MASS.

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AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DISEASES OF THE TOMATO

—BY—

George E. Stone.

Although tomatoes are quite susceptible to disease here, they are much more so when grown in the Middle and Southern States, where the climatic conditions are more favorable for severe outbreaks. In this State field tomatoes are troubled more or less with fruit rots and leaf blights, such as are caused by species of bacteria, Septoria, Cladosporium, Alternaria, etc. Tomatoes under glass also have their troubles, but these differ somewhat from those common to plants out-of-doors. Since the environment of greenhouse plants is quite different from that of those grown out-of-doors and is very largely under control, it is more practicable to apply preventive methods of treatment. Spraying should be the last resort in greenhouse culture, and even when it is thought necessary to apply this method of treatment, it should be considered merely temporary.

The great degree of skill developed by our master florists and market gardeners has demonstrated in a great many instances that the proper handling of conditions, or modification of environment, is sufficient to hold most troubles in check. The skilled gardener learns to know his plants thoroughly; he is familiar with their condition and succeeds in maintaining the proper relationship between the plant and its environment, which enables him to accomplish wonderful results. The three principal factors in greenhouse management, viz., heat, light and moisture, must be judiciously handled, and when their control is in the hands of an expert, many of our common troubles are entirely avoided. Our experiments and observations on tomato diseases have extended over many years, and it is not our purpose to give in detail the various experiments carried out. We shall confine ourselves merely to a resumé of the results obtained.

BLOSSOM END ROT,—FRUIT ROT

One of the most troublesome diseases affecting tomatoes throughout the United States, and which occurs on greenhouse-grown and field plants is what is termed "fruit rot." There is often more than one organism associated with this rot, and much confusion has existed, not only in regard to the nature of the

specific organism responsible for this trouble, but also as to the efficacy of certain remedial measures.

The fungus *Macrosporium tomato, Cook*, is associated with a tomato rot, and according to Jones and Grout[1] is the same as *Alternaria fasciculata, (Cke., Jones and Grout)*. It is, however, a saprophytic species widely disseminated and not capable in itself of producing tomato rot, whether applied to the fruit externally or internally. This view has been confirmed by F. S. Earle[2] and Miss E. H. Smith, both having found it impossible to produce tomato fruit rots by inoculations with the fungus. On the other hand, B. T. Galloway, who was among the first to give tomato rots serious attention, found that the spores of the *Macrosporium tomato* would not cause rot when placed on the smooth cuticle of the fruit, but when the exposed inner tissue was inoculated or the spores were placed in fissures on the surface of the tomato, rot followed very quickly. The evidence derived from observations and experiments therefore would seem to preclude the probability of Macrosporium being the sole cause of tomato rot.

Dr. Galloway[3] also found, in connection with the tomato rot, a fungus known as *Fusarium solani, Mart.*, which he associated

Fig. 1, showing blossom end rot of tomato.

with the rot. His inoculation experiments showed that when the spores of this fungus were placed on the injured cuticle of either green or ripe tomatoes, no infection occurred, but when they were inserted under the skin of green, half-ripe and ripe fruit, only the latter rotted, and these were affected very quickly.

Miss Smith isolated a species of Fusarium from greenhouse tomatoes, which in only one instance, however, produced a characteristic rot on green fruit when the fungus was placed about the style, but in numerous cases rot was produced on both the green and ripe fruit when inoculation was made by puncturing

1. Vt. Agr. Exp. Sta., 10th Ann. Rept., 1896-97, pp. 50, 51.
2. Ala. Agr. Exp. Sta., Bul. No. 108, 1900, pp. 19—25.
3. U. S. Dept. Agr. Rept., 1888, p. 344.

the epidermis. Fusarium has frequently, but not always, been found by us growing on sections of tomato fruit in sterilized Petri dishes. An abundance of bacteria of a uniform character was also present along with the Fusarium, and when inoculations were made from isolated forms, the rot was always produced.

The same type of bacterial organism was repeatedly found by Miss Smith in her investigations, and this has been described by her in technical bulletin No. 3 of this Station. Numerous observers have noted bacteria in connection with these tomato rots. F. S. Earle, after three years' study, came to the conclusion that a species of bacillus was the sole cause of the rot, and William Stuart[1] isolated a bacillus from a tomato rot found in a greenhouse in Indiana which would appear to be similar, if not identical, with that described by F. S. Earle and Miss Smith. B. D. Halsted,[2] on the other hand, considered tomato rot in New Jersey as being caused by *Macrosporium tomato, Cook.*

F. C. Stewart[3] mentions Macrosporium and a species of Fusarium as being present in tomato rot which he studied, and S. A. Beach[4] published a note on a tomato rot found in a greenhouse. F. C. Stewart, who made an examination of the disease, failed to identify any fungus trouble or isolate any organism. He mentions bacteria as being present in small numbers.

Our observations on the rot, which have been extensive, coincide with those of F. S. Earle and Miss Smith, namely, that bacteria are the primary cause of the tomato rot and the presence of fungi is always secondary; and that in all probability most, if not all, of the so-called blossom end rot of tomatoes is caused by a specific bacterial organism. The bacilli isolated repeatedly by Miss Smith and myself are identical and appear to be the same as those briefly described by Earle and Stuart.

THEORIES IN REGARD TO THE CAUSE OF ROT

There are various ideas concerning the causes which underlie susceptibility to tomato rot. It has been maintained that soils too rich in nitrogenous fertilizers induce the rot, and that those plants fertilized with potash and phosphoric acid show more rot than those which are not fertilized. Some claim that a rainy season favors the rot, but practically all of the experienced growers of tomatoes whom we have consulted maintain that a dry season is more favorable for rot than a wet season.

Prof. L. H. Bailey has stated that heavy applications of

1. Ind. Agr. Exp. Sta., 13th Rept., 1900, p. 13.
2. N. J. Agr. Exp. Station, 24th Rept., 1903, p. —.
3. N. Y. (Geneva) Agr. Exp. Sta., 14th Rept., 1895, p. 529.
4. N. Y. (Geneva) Agr. Exp. Sta., Bul. No. 125, 1897, p. 305.

manure appear to aggravate the disease, an idea which Dr. B. T. Galloway has found to prevail generally. He also found that certain varieties were less susceptible to rot than others, and that a wet soil or mulching induces it. On the other hand, free access to the air, obtained by careful pruning, prevented rot.

A. D. Selby's[1] observations, extending over several seasons, seem to show that tomato rot is associated with insufficient moisture in the soil. He found that the amount of rot was decidedly more on surface watered plants than on those sub-irrigated, and that similar results took place with irrigated plants in the field during periods of drought. These observations appear to have been verified by W. J. Green and C. W. Waid.[2] They found that sub-irrigation gives the best growth and serves as a check to black rot. They recommend an abundant supply of water at all times while the plant is growing, and especially after tomatoes have reached a considerable size. They found that rot was not very troublesome, except in cases where surface watering was practiced, or when the water supply was deficient.

F. S. Earle believes that infection is associated with attacks of such insects as thrips, boll weevils, etc. Both he and Miss Smith found that infection would not be produced by coating the stigma with a culture of an isolated bacillus. Our observations seem to point to the conclusion that most of the infection occurs through fissures near the base of the style. Fissures and irregular cell formations are very common on tomatoes at this point, and when the style falls off a more or less rough scar often remains which favors infection.

SPRAYING FOR TOMATO ROT

Many experiments have been made relating to the control of tomato rot, and there are many conflicting ideas relating to the effect spraying might have on the disease. P. H. Rolfs[3] found that spraying with Bordeaux mixture proved a very efficient preventive for this trouble in Florida, and Howell[4] obtained positive results from the use of Bordeaux mixture. He sprayed three times, at intervals of two weeks, beginning when the fruit was an inch or more in diameter. The results of his work show 4% of rot on the sprayed plants and 60% on the unsprayed. F. C. Stewart found that sprayed tomatoes suffered much less from rot than those unsprayed. B. D. Halsted and L. H. Bailey[5] also report beneficial results from spraying.

F. S. Earle, on the other hand, states that in a laboratory

1. Ohio Agri. Exp. Sta., Bul. No. 73, 1896, pp. 241-242.
2. Ohio Agr. Exp. Sta., Bul. No. 153, 1904.
3. Fla. Agr. Exp. Sta., Bul. No. 121, 1893, p. 37.
4. U. S. Dept. Agr. Section Veg. Path., Bul. No. 11, 1890, pp. 61—65.
5. N. Y. (Cornell) Agr. Exp. Sta., Buls. Nos. 28 and 32, 1891; also see Bul.

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experiment he sprayed tomatoes, thoroughly ten times with the Bordeaux mixture, begining when the first rough leaves were formed and continuing until the ripening of the fruit. "The treatment did not have the slightest effect in controlling the disease."

Our own observations on the use of the Bordeaux mixture for the control of tomato rot have not always been of the most encouraging nature.

INVESTIGATIONS ON THE BLOSSOM END ROT OF TOMATOES

Our observations on and investigations of the blossom end rot of tomatoes under glass have extended over a period of sixteen years and many series have been recorded. From the first our observations and experiments were made on the influence of moisture conditions surrounding the plants, as it was believed that the rot was associated with the moisture conditions of either the soil or air, or both.

Investigations concerning the particular organism causing the rot were made by Miss E. H. Smith*, a former student, and her work has been repeatedly verified in our laboratory and greenhouse.

That soil moisture is an important factor in the control of blossom end rot in the greenhouse, as pointed out by A. D. Selby, is shown in the experiments which follow, but it should be stated that there are many factors, such as light, transpiration, plant foods, etc., which play an important role and which may be of sufficient importance if not properly controlled to overcome the effects of sub-irrigation to some extent, at least.

A liberal supply of soil moisture appears to cause the formation of more perfect fruit, thus eliminating the possibility of infection; on the other hand, a plant not supplied with sufficient moisture has a greater tendency to produce fissures and abnormally developed tissue at the blossom end of the fruit, near where the style breaks off, providing a suitable entrance for germs. A large number of observations was made on top-watered and sub-irrigated plants, and records kept of the corky growths, irregular formations, fissures, etc., at the blossom end of the fruit, with the result that the top-watered plants produced a larger percentage of these irregular formations than those grown in sub-irrigated soil. These cracks, etc., furnish a suitable entrance for the bacterial organisms which are largely responsible for the rot, if not in all cases, and the occasional

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*Mass. Agr. Exp. Sta., Tech. Bul. No. 5, 1907.

presence of such fungi as Fusarium and others is of purely secondary importance, according to our observations.

The experiments which follow have been carried on for some years, and it should be pointed out that the houses in which the experiments were conducted were not the best arranged to prevent the rot. Although well adapted to the growth of certain crops, they were not well suited to that of others, and conditions were hardly such as would be found in a good commercial house. In short, our plants were under different light and atmospheric moisture conditions than usually prevail in commercial establishments. The blossom end rot in greenhouses in this State seldom exceeds fifteen or twenty per cent, and as a rule is not a source of heavy loss to greenhouse growers, although in the field this percentage of loss is often exceeded, and in some parts of the United States tomato rot is a serious disease.

Table Showing Result of Experiment with Blossom End Rot of Tomatoes as Affected by Sub-irrigation and Top-watering.

TABLE I.

No. of Series.	Per cent of rot. Sub-irrigated.	Per cent of rot. Top-watered.
No. 1,	4.5%	23.5%
No. 2,	4.7	44.5
No. 3,	0.0	11.0
Average,	3.0%	33.0%

The experiments shown in the preceding table were conducted as follows:

In series No. 1 the plots were grown in a bed 20 feet long, 3 feet wide and 8 inches deep. This bed was divided into two equal parts, one-half being sub-irrigated and the other half top-watered. One-half of this bench, or the sub-irrigated part, was lined with zinc and filled with bricks with the lower edges clipped to furnish more space for water. The bricks were covered with soil and the water was supplied to the bottom of the bench under the brick. The other half of the bench was simply filled with soil and the plants top-watered.

In series No. 2 the plants were grown in boxes 14x14x14 inches, inside measurement. The boxes containing the irrigated plants were placed in galvanized iron trays holding water, holes being bored in the bottom of the boxes to allow the water to rise through the soil above, or in some instances, they were without bottom.

In series No. 3 the sub-irrigation was accomplished by burying perforated 2-inch galvanized iron pipes in the soil and supplying the water through these. In all cases the sub-irrigated plants were grown either alternately or in a bench beside those plants which were top-watered, and all differences likely to arise from exposure, etc., were obviated so far as possible. It should be pointed out, however, that the results given in the tables represent the averages of many crops growing under similar conditions, in which a number of plants was employed in each experiment. Individual variation has therefore been largely eliminated, and the results should represent fairly true averages.

From a study of the results shown in Table I it will be noted that the percentage of rot was much less in the sub-irrigated plots than in the top-watered plots. Careful records were also kept of the weight of the fruit as well as of the yield, with the result that the average weight of the fruit of the sub-irrigated plants was found to be 36% more than that of the top-watered plants. There was a difference of 17% in the amount of fruit produced in favor of the sub-irrigated plants, which exhibited a more luxuriant growth and developed thicker stems and darker colored foliage, besides setting their fruit earlier as a rule than the others.

After the above experiments were completed, some further experiments were made during the summer of 1908 under the personal supervision of Director Brooks, relating to the influence of soil moisture on the blossom end rot. These experiments were made in galvanized iron pots containing about 35 pounds of soil, all of which was treated with a complete fertilizer. The pots were placed on trucks and were kept outdoors, except in rainy weather, when they were removed to the greenhouse. Nine pairs of pots were arranged and the water content of the soil was maintained at 50% of the total capacity, until the plants commenced to blossom, after which time the water contents ot the pots were maintained as follows:

Table II, Showing Pot Experiments with the Blossom End Rot of Tomatoes.

Pair	1,	Pots	A and B,	containing	15% moisture.
"	2,	"	A and B,	"	25% "
"	3,	"	A and B,	"	35% "
"	4,	"	A and B,	"	45% "
"	5,	"	A and B,	"	55% "
"	6,	"	A and B,	"	65% "
"	7,	"	A and B,	"	75% "
"	8,	"	A and B,	"	85% "
"	9,	"	A and B,	"	90% "

The purpose of these experiments was to ascertain the optimum amount of water necessary to hold the rot in check. The plants in the first four series of pots (1—4) were much inferior to those in the last four series (6—9). In the first four series the plants were more or less stunted and in the last four, which contained more water, the plants had more foliage and more and larger fruit, and appeared healthier. In the first series, in which the water was less than 55%, there were 11 cases of blossom end rot, while in the series in which the water exceeded this percentage there were eight cases of rot. The results of this single experiment, however, are not conclusive, but they indicate that the presence of a certain amount of water exerts an influence on preventing the rot, and verify our own experiments to a certain extent. However, many factors enter into a problem of this nature, and a single experiment in pots was not on a large enough scale to be conclusive. Moreover, top-watering is entirely different from sub-irrigation, whether in pots or in beds, as shown by Selby's and our own experiments.

For the control of blossom end rot it is necessary that the soil contain the required amount of water, when the fruit is setting, and during its early maturity. A pot might be abundantly supplied with water at the surface of the soil in the morning, and on a very dry day would dry out before the next watering if the soil was of a loose texture.

It is quite evident from the result of our experiments on the blossom end rot of tomatoes that the presence of water in liberal amount in the soil is of the greatest importance. Watering by sub-irrigation is quite different from surface watering, since in the former method the water is most easily obtained by the roots. The surface of the soil may be comparatively dry, and the lower stratas well supplied with water in the sub-irrigation beds, while quite the reverse often occurs in the top-watered beds. The inexperienced gardener, when applying surface water, too often has little conception of the conditions below the surface. The roots of tomatoes, when not restricted in growth, will extend to quite a depth in good loam, and when surface watered, it often happens that the upper layers of soil get sufficient moisture, but the lower stratas which are well filled with roots, remain comparatively dry. Then again, when water is supplied even liberally to the soil there may be periods when the soil dries out very rapidly, and the plant may suffer from lack of water, as a result of which the rot will often occur.

In controlling the blossom end rot in the greenhouse great care should be exercised as regards the percentage of moisture in the air. It is not advisable to keep the air too dry, especially during bright sunshine; on the other hand, the air in the house

should not be too moist at night, as this condition may cause mildew (Cladosporium). In greenhouse culture the careful use of water and the proper control of the moisture and light conditions, should reduce the blossom end rot to a minimum. For field culture supplying the crops with sufficient water would prove beneficial. The irrigation of field crops will become more general in the future, and will undoubtedly exert an influence not only on the yield of the crop, but on the susceptibility to certain troubles.

RELATION OF EXTERNAL CONDITIONS TO BLOSSOM END ROT

The application of water to soil by sub-irrigation, even in large amounts, is not always successful in preventing the blossom end rot, as there are other factors which play an important part, as already pointed out. While experimenting we had occasion to observe the influence of the various external conditions on the rot and gained some idea of their importance. One of the most important factors which influences plant development is sunshine, and when tomato plants are exposed to bright sunshine conditions may arise which render the plants more susceptible to the rot, as is shown in the following table.

TABLE II.

Tarle Showing Effects of Bright Sunshine on Blossom End Rot of Tomatoes.

	Bright Sunshine.	Shaded.
Number of fruit,	223	345
Per cent of rot,	36	1.7

The results shown in Table II give the differences in the percentage of rot occurring on plants growing in the same house in the same type of soil, but differently exposed. Those in the front rows were exposed to strong sunlight, while those in the back row were more or less shaded. The amount of rot on the plants in bright sunshine was 36%, while in areas partially shaded it was only 1.7%. The influence of sunlight on the rot is associated purely with transpiration, since in the sunlight plants transpire more than when partially shaded, and if transpiration is active, more water is withdrawn from the plant, and some portion of the plant may suffer. If water is withdrawn from the fruit, cracking is more likely to occur, and the blossom end rot will follow.

Transpiration is more active, of course, in a house where the

atmosphere is dry, but it is also active even where there is more or less moisture when the sun is bright.

The influence of sunlight on the blossom end rot is very clearly shown in the susceptibility of crops grown at different seasons. In the fall, when the light is poor, the disease is uncommon in the greenhouse, whereas as the season advances and the sunlight becomes more intense, the blossom end rot increases. In a greenhouse the sunlight from February on is comparatively intense, and it is then that the blossom end rot is most troublesome. It is also more common in a house where the atmospheric moisture is kept down. The plants in our experiments were in all cases grown in benches more or less close to the glass, with the rows not very close together, which is not often the case in commercial houses. When tomatoes are planted so closely that they are more or less shaded, the light is not such an important factor in causing rot. The proximity of tomatoes to steam and hot-water pipes is conducive to rot, since the heat accelerates transpiration; moreover, the soil dries out more quickly under these conditions and root absorption is decreased. In practically all of our experiments those plants located near steam pipes and at the ends of beds were more susceptible to rot than others. In the spring, when the sun is very bright, partial shading of the plants by whitewashing the glass or other means should prove useful in holding the rot in check by lessening transpiration.

Fertilizers and manures are also capable of inducing a tendency to rot, since they modify root absorption more or less and restrict the amount of water which the plant can take in. The greatest source of danger in this respect occurs in the excessive use of nitrates, and one should be careful in applying fertilizers and manures containing large amounts of nitrates. Where there is an excess of nitrates in the soil it can be easily detected by chemical analysis of the leaves.

CONCLUSIONS REGARDING THE BLOSSOM END ROT

From what has been stated regarding the various factors which may influence blossom end rot it is quite evident that we have here a complicated problem to deal with. Besides the necessity of applying water freely to the roots as a means of preventing the rot, it is well to pay attention to other factors, such as light, heat, moisture, etc., which induce the rot if not properly handled.

In general, it may be said that sunshine is the principal determinative factor in greenhouse management, since crops grow and develop in proportion to the light they receive. It also affects

the plant in many other ways, by modifying its structure and functions. At the present time it is impossible to determine quantitatively all of the factors which influence plant development, but in the future methods will undoubtedly be developed which will enable us to determine how many heat or light and moisture units are required to develop a plant to a certain stage, and to know more about the exact relationship of these factors to tissue formation and blights.

Owing to the lack of practical methods of determining quantitatively the conditions in a greenhouse, only general directions can be given in regard to the control of certain factors. We know, for example, that a certain amount of atmospheric moisture maintained in a house for a certain length of time will cause mildew, and that a lack of soil moisture will induce the blossom end rot. We also know a great deal about the effects of cold air, light, heat, etc., on plants as regards infection, and in some cases more or less specific directions can be given as regards the management of the house. It is necessary, however, that the gardener acquire skill and judgment in handling a crop, and the more he acquires the less he will be troubled with diseases.

The effects of too much sunshine on the plants are obviated to a considerable extent by certain methods of planting. When the plants are set 12 or 15 inches apart and the rows are more or less close to one another (2 feet), there is some shading, and transpiration is checked. On the other hand, too close planting, especially in the fall, when the light is deficient, may induce leaf spots. Concrete walks in a house materially affect the moisture in the air, and if the soil is dry the air is likely to become deficient in moisture.

We have found in some of our experiments that too much water is disastrous to the crop. In some cases the foliage turned yellow quite early and the plants died prematurely. The soil in such cases was very soggy and not suited to root development. This condition was present when an excess of water was applied, particularly in the zinc-lined benches where there was no drainage.

Too high night temperatures always result in the formation of a more tender tissue, which loses water rapidly, and as a consequence the plants wilt more easily. On general principles, therefore, lower night temperatures should be maintained during periods of cloudy weather, and too high day temperatures should not be run immediately following cloudy weather.

Since the blossom end rot, in consequence of the poor light in the fall, is not so common in the greenhouse then as in the spring, less attention has to be given to its control during that season, since transpiration is less active. As the amount and

intensity of the sunlight increase more attention should be given to the water supply and to air moisture. The air moisture should be considerably more during the day, particularly on bright days, than in the night. If syringing the foliage is necessary, it should be done in the morning, when the bright sunshine will dry the foliage quickly, and never at night, as moisture remaining on the foliage at night favors the development of mildew.

TIMBER ROT

(Sclerotinia Libertiana, Fckl.)

The fungus causing what is termed "timber-rot" is occasionally found on tomatoes, and the effects are similar to those produced by the stem-rot of cucumbers. Tomatoes, however, are not as susceptible to timber-rot as cucumbers, although when

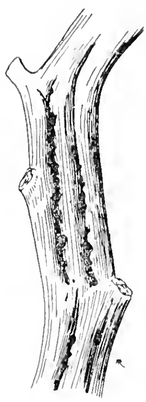

Fig. 2, showing timber rot on the stem of tomato. The blackened areas on the stem represent masses of sclerotia.

affected, the crop is greatly injured. We have repeatedly grown crops of tomatoes in soil badly infected with the timber-rot fungus, but as a rule only a few plants become diseased, and from this it would appear that tomatoes are generally immune to attacks from Sclerotinia.

Sclerotinia is a sterile soil fungus, and gains entrance to the plant near the surface of the soil. When the plant becomes infected the fungus traverses the stem and breaks out some distance above the ground, the part of the stem affected becoming whitish in appearance. Small, hard, black masses called sclerotia, about 1/32 or more of an inch in diameter, make their appearance on the surface of the stem. These sclerotia are capable

of throwing out filaments, or germinating and affecting other plants. Dessicating or drying the soil greatly increases the activity of the sclerotia, and infection in the succeeding crop is thereby materially increased.[1]

A similar disease caused by a species of Sclerotinia, which appears to be responsible for a large amount of damage to tomatoes and other crops in the South, has been noted by P. H. Rolfs[2] in Florida, and attention has been called to this by F. S. Earle[3] in Alabama. Since the disease has not proved to be of great importance on tomatoes in Northern greenhouses up to the present time, remedial measures are not urgently needed; but should it ever become so, soil sterilization will be found efficacious, and the treatment of the soil with formalin may prove valuable.[4]

SCAB OR MILDEW

(Cladosporium fulvum, Cke.)

This fungus is characterized by a velvety, mouse-colored mildew-like growth forming irregular spots on the under surface of tomato leaves. On the upper surface of the leaves these spots are yellowish in color. The fungus penetrates the leaf tissues and occasionally overruns the surface, thus causing much injury. It attacks both field and greenhouse tomatoes, and while we have never known of its completely killing the crop, it frequently causes much injury. It is much more common and severe in moist than dry weather.

For the treatment of field crops the best remedy consists in spraying with any good fungicide such as the Bordeaux mixture, applied as occasion demands. For the control of the disease in greenhouses, W. F. Massey and A. Rhodes[5] have recommended the use of lime and sulphur applied to the steam or hot-water pipes. The most successful method we have found for controlling mildew consists in keeping the atmosphere of the house dry. Our experiments have extended over a period of many years, and we have carried through many crops without the slightest trace of this mildew. It is a comparatively easy matter to produce mildew in a house, and we have shown that by covering individual plants with glass or a cloth and greatly modifying the light and moisture conditions, mildew results.

Watering or syringing the foliage should be done only on

1. Mass. (Hatch) Agr. Exp. Sta., Bul. No. 69, 1900, p. 22.
2. Fla. Agr. Exp. Sta., Ann. Rept., 1896, pp. 38—47; also Buls. Nos. 21 and 47.
3. Ala. Agr. Exp. Sta., Bul. No. 108, 1900, pp. 28—32.
4. Ohio Agr. Exp. Sta., Cir. No. —.
5. N. C. Agr. Exp. Sta., Bul. No. 170, 1900, pp. 6—7.

bright, sunshiny days, when it will dry off quickly, and care should be taken to maintain suitable moisture conditions of the air during the night.

We have grown crops of tomatoes under glass every month in the year, and find that if proper attention is given to moisture,

Fig. 3, showing tomato leaf affected with mildew or scab (Cladosporium).

ventilation and light one need have little fear of tomato mildew under glass.

SLEEPING DISEASE OR WILT
(Fusarium Lycopersici, Sacc.)

This trouble has been described by G. P. Clinton[1], who has noted its appearance on greenhouse tomatoes and who states that the disease does not usually show itself until the plants have attained full size and begun to bloom.

He characterizes the disease as follows: "At first a lower leaf or two will wilt, turn yellow and finally die. Gradually the disease works up, successive leaves drying up and dying on the vines." Microscopical examination shows a discoloration of the vascular bundles of the leaf petioles and stems, which are more or less filled with the mycelium of the fungus. This causes a clogging of the vessels and interferes with the transference of water, resulting in wilting. Dr. Clinton surmises that the fungus infects the plant through the soil, and that sterilization might succeed in preventing infection.

During the past few years a similar trouble has been noted in many greenhouses, causing more or less serious trouble. In several instances Fusarium has been observed by us, affecting

1. Conn. Agr. Sta., 27th Ann. Rept., 1903, p. 366.

the stems near the surface of the soil most severely. This causes the plant to wilt, but the disease has apparently not been common enough to cause much injury. At the present time (1910) a serious and very destructive Fusarium wilt similar to that found on tomatoes, has destroyed a number of indoor crops of cucumbers in the Northeastern United States. Much injury has been done to field tomatoes in Missouri, Illinois[1] and other States by this wilt, but no efficient method of control has been discovered.

Extensive forcing and other innovations in methods of growing plants have been the cause of most stem rots, which have

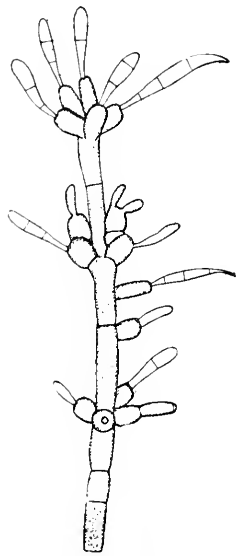

Fig. 4, showing filaments of fungus Fusarium, with conidia of the blossom end rot of tomatoes.

increased materially during the past decade. From observations on Fusarium wilts we are convinced that something might be gained by the use of seedlings which are well hardened and by planting not too deeply. Some years ago we observed that aster seedlings grown under glass were more susceptible to Fusarium stem rot than those grown outdoors. The light and heat conditions under glass were not like those outside, and the tissue of the field plants was much more hardened than of those grown inside, consequently was much less susceptible to Fusarium rot.

1. Ill. Agr. Exp. Sta., Bul. No. 144, p. 82–83.

DOWNY MILDEW

(Phytophthora infestans, DBy.)

The downy mildew of tomato is rarely seen in Massachusetts. It is caused by the same fungus which is responsible for the well-known blight of potatoes.

In September, 1905, this mildew caused considerable injury to field grown tomato plants in this State,[1] and occurred during a period of heavy rainfall. Previous to this rainfall there had been a long period of drought.

The same disease appeared to cause serious trouble in California[2] during that season, and was associated in that State with heavy rainfall.

The customary Bordeaux treatment recommended for potatoes will undoubtedly prove effectual for the downy mildew of tomatoes in case it should become prevalent.

ANTHRACNOSE

One or more fungi (Colletotrichum, etc.) are responsible for a fruit rot which has occasionally been observed in this State, but no serious damage to crops has been reported in this locality. It generally causes sunken blotches on the side of the mature

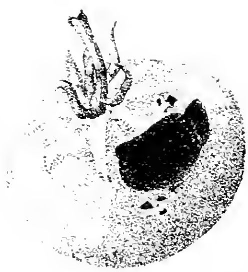

Fig. 5, showing Anthracnose (Colletotrichum) on tomato fruit.

fruit, and in severe cases the whole fruit eventually becomes affected and decay quickly follows. The disease has been described by different writers and its appearance has been noted in widely separated localities.

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1. Mass. (Hatch) Agr. Exp. Sta., Ann. Rept., 1906, p. 115.
2. Cal. Agr. Exp. Sta., Bul. No. 175, 1906, p. 9.

F. D. Chester,[1] who studied this disease, was more or less confused in finding two different types of fungi associated with the rot, and V. W. Pool,[2] who has recently investigated the disease, claims that in all probability there are two distinct Anthracnoses affecting the tomato. F. M. Rolfs,[3] who has had considerable experience with this disease in Florida, maintains that it can be held in check by spraying with Bordeaux mixture.

LEAF BLIGHT

(Cylindrosporium, sp.)

Considerable trouble has been experienced with this blight on Long Island[4] and in New Jersey.[5] It occurs as brownish spots on the leaves, and as the trouble progresses it involves the

Fig. 6, showing leaf spot (Cylindrosporium) on tomato leaf.

whole leaf, causing it to turn brown and dry up. In severe cases of infection practically all the foliage may be destroyed.

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1. Del. Agr. Exp. Sta., Ann. Rept., 1891, p. 60; 1892, p. 80; 1893, pp. 111–115.
2. Neb. Agr. Exp. Sta., Ann. Rept., 1908, pp. 9—15.
3. Fla. Agr. Exp. Sta., Rept., 1905, pp. 45—46.
4. N. Y. (Geneva) Agr. Exp. Sta., 14th Ann. Rept., 1895, p. 529.
5. N. J. Agr. Exp. Sta., 15th Ann. Rept., 1894, p. 361.

The trouble has occasionally been observed in this State on greenhouse tomatoes.

For field crops spraying has been recommended. In the greenhouse the remedy is more simple, since the disease, according to our observation, results from too much crowding, and is of rare occurrence here.

A similar spot is often found on chrysanthemums. On both tomatoes and chrysanthemums the disease is confined to the lower shaded leaves of closely planted crops, and it has never been observed by us on individual plants of chrysanthemums grown in pots or where light and air have access to the foliage. In the fall and winter, when the light is poor, the lower leaves of crowded plants often deteriorate and show signs of prematurity; consequently becoming more susceptible to disease.

To prevent this trouble the crop should not be planted too closely, and the foliage should receive more air and sunlight. On too closely planted tomato plants the lower leaves may be removed, and if diseased, destroyed. The pruning of the lower leaves is not harmful and lets in more light and air where it is needed.

LEAF BLIGHT

(Septoria, sp.)

Leaf blight (Septoria) is frequently seen on field crops of tomatoes, but we have not noticed it on crops grown under glass.

Fig. 7, showing leaf spot (Septoria) on tomato leaf.

and on the whole the disease is not serious in this locality. It is reported as being rather serious in New Jersey, Ohio and the South, and it has recently caused much trouble in the Middle West.

This disease is distinguished from other leaf diseases by the presence of circular spots, at first appearing on the lower leaves. The infection increases with the development of the plant, and in severe cases little remains of the plant but bare stems and small, stunted fruit. B. D. Halsted,[1] who was the first to call attention to this fungus, and who has had considerable opportunity to experiment with it, finds that it yields to treatment with the Bordeaux mixture. The first spraying should be given about two weeks after transplanting, followed by two or three additional sprayings at intervals of three weeks.

J. W. Lloyd, and I. S. Brooks[2] have demonstrated that repeated spraying of tomatoes reduces leaf blight materially and greatly increases the yield of fruit.

LEAF MOLD

(Alternaria Colani (E. & M.), Jones & Grout.)

The fungus causing leaf mold is the same as that giving rise to the early blight of potatoes. It often occurs on the leaves and fruit of field crops, but we have never observed it on greenhouse plants. The leaves affected with this fungus present at first minute spots, which gradually enlarge and become marked with concentric lines. These spots are sometimes associated with the injuries caused by the flea beetle.

The remedy advocated is similar to those that are applied for the early blight of potatoes, namely, spraying with some good fungicide.

BLIGHT

(Bacillus Solanacearum, Smith.)

This disease has not been observed in this State up to the present time, but has caused considerable injury farther South. E. F. Smith[3] has fully described the disease and recommended as precautions against it an early and complete destruction of insect pests, and the removal of any diseased vines. He also

1. N. J. Agr. Exp. Sta., Ann. Rept., 1895, p. 294.
2. Ill. Agr. Exp. Sta., Bul. No. 144, 1910, p. 78—82.
3. U. S. Rept. Agr., Div. Veg. Path. and Phys., Bul. No. 12, 1896.

advises the use of land on which there have been no diseased plants, together with seed taken from localities where the disease has not existed.

J. S. Robinson[1] found that by spraying plants affected with this blight three or four times in the summer with the Bordeaux mixture, an increased yield of from 2.2 to 2.5 tons per acre was obtained.

EEL WORMS,—NEMATODES

(Heteradora radicicola, (Greef.) Müll.)

One of the common troubles on indoor tomatoes is caused by nematodes,—small worms which inhabit the soil. They gain entrance to the young roots, where a part of their development takes place. The presence of these minute worms in the tissue of the roots causes a reaction on the part of the cells, resulting in the formation of galls. On tomato roots many galls are formed, which cut off the water supply and cause more or less injury to the crop.

These worms also attack cucumbers and melons, and sometimes lettuce; in the greenhouse melons being especially susceptible. Since tomato plants are more hardy than either cucumbers or melons, they naturally suffer less from the effects of eel worms.

Eel worms are very susceptible to treatment by desiccation, freezing, excess of water, and high temperatures, and the methods of treatment are based upon our knowledge of the influence of these factors upon the organisms. Desiccation, or drying the soil, has been employed in Europe on field crops and is very satisfactory when applied on a small scale in a greenhouse, but with deep benches we did not find the method effective. Removing the soil and replacing it with new, or freezing it, is quite effective, and the so-called catch-crop method has proved successful in some instances. This method consists in planting some crop like mustard or rape before the regular crop is planted, and when the galls are well formed the crop is dug up and the roots exposed to the drying action of the sun, which kills the worms. By this method the females are captured and destroyed at the most advantageous time. We have experimented with the catch-crop method in the greenhouse and found at times that it was fairly successful, especially when more than one catch-crop was planted.

A variation in the catch-crop method, consisting in sowing some crop susceptible to eel worm infection at the same time

1. Md. Agr. Exp. Sta., Bul. No. 54, 1898, p. 122.

that the regular crop is planted, might prove useful, since the organisms, according to our observations, show preferences in regard to the host attacked. The crop could be managed somewhat similarly to a cover crop, and when the roots are well infected, which would be in a few weeks, the crop could be pulled up and destroyed and another planted in its place.

One of the most practical methods of ridding a house of eel worms, when the proper facilities are at hand, consists in sterilizing.[1] With special appliances this can be done effectively at no great cost, and is on the whole the cheapest and best method of destroying this pest.

Fig. 8, showing eel worm galls on tomato roots.

In our sub-irrigation experiments with tomatoes we found that water allowed to remain in the soil for any length of time was very injurious to eel worms. In the boxes and plots which were sub-irrigated eel worms were rare, and in most instances entirely absent, whereas on the top-watered plants in all cases

1. Mass. Agr. Exp. Sta., Hatch, Bul. No. 55, 1898; also Hatch Exp. Sta., Rept., 1902, p. 74; Hatch Exp. Sta., Report, 1905, pp. 10—14; Hatch Exp. Sta., Rept., 1903, p. 38; Mass. Agr. Exp. Sta., Rept., 1909, pp. 58—61.

there were numerous galls. Some further experiments were made along similar lines which showed the injurious influence of water on eel worms. Dr. E. E. Bessey, of the United States Department of Agriculture, recently informed us that he had observed the same thing in the South along river banks where the soil is inundated for a certain length of time each year. The application of excessive amounts of water to the soil for brief periods of time might prove a practical method of ridding soil of this pest.

Parasitic eel worms are not indigenous to this region on account of our severe winters, and infection comes about largely from the use of manures containing refuse in which eel worms are present.

If once thoroughly eradicated from a greenhouse, precautions should be taken in regard to the introduction of manures or soils contaminated with eel worms, as well as plants from infested houses.

Florists frequently make use of liquid decoctions of manure in feeding their plants, and since eel worms are destroyed by water, this practice should cause little trouble.

SURFACE MOLDS

(White Fly Excretions.)

Tomatoes under glass suffer to a considerable extent from the excretions of the greenhouse white fly (Aleyrodes). When this fly becomes abundant and is allowed to thrive in the house the plants become coated with a sticky substance (honey-dew), which forms a favorable medium for the development of surface molds which cover a considerable part of the foliage and cause much injury to the plant in one way or another. The remedy is obviously to destroy the flies.

Following the advice of Dr. H. T. Fernald, entomologist to the Station, we have used hydrocyanic acid gas successfully for white flies. The following formula has been used repeatedly by us without appreciable injury to the plants, and we succeeded in destroying all the flies.

10 gms.* fused cyanide of potassium (98-99% pure).
20 c. c. commercial sulphuric acid.
40 c. c. of water to 1,000 cubic feet of space.

Turn the acid into the water in an earthen or graniteware jar and then, by a loose bag and string, drop the cyanide in, after tightly closing the place to be fumigated.

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*28 gms. equal 1 oz.

Dr. Fernald advises fumigating at intervals of about two weeks, keeping this up as long as the fly is present, as one fumigation does not kill all stages of the insect. Three fumigations, however, if properly made, should practically exterminate it.

It should be remembered that cyanide of potassium is a virulent poison, and that breathing the gas would be fatal. The house must be thoroughly aired before it is re-entered.

BURN OR SCALD

A disease known as burn or scald, which is of rare occurrence, is characterized by a wilting and drying up of leaves of tomato plants. W. C. Sturgis and S. W. Johnson[1] have given a description of this trouble as it occurred in the Connecticut Station greenhouse, and they attribute it, as do also B. T. Galloway and L. H. Bailey, to burning resulting from sudden exposure to bright sunshine after a period of cloudy weather, or to insufficient water supply to the roots, especially when plants have been accustomed to warm, moist air and plenty of water. It may be noted that similar troubles often affect cucumbers and lettuce under glass (topburn, etc.). These may be brought about in different ways; for example, by maintaining a too high night temperature during cloudy weather. Plants grown under optimum temperature conditions in properly lighted and ventilated houses, especially where attention has been given to their care during cloudy weather, are not likely to be affected with this trouble, inasmuch as such troubles occur only when conditions are in marked degree abnormal.

HOLLOW STEM

P. H. Rolfs[2] mentions this trouble as occurring in Florida. Plants suffer from this disorder immediately after being set out from the seed-bed, whether they be only a few inches high or eight or ten inches when transferred. The central portion of the head of the plants remains green, while the large leaves turn slightly yellow; then in the course of a week or ten days after setting out, the most severely affected plants fall over, as if cut off by worms, and on examination it is found that the lower part of the stem is hollow, leaving only the epidermis to support the plant.

Plants affected with hollow stem make little or no growth. Prof. Rolfs found that this trouble is caused by forcing the plants in the seed-bed, and anything which induces a soft, watery

1. Conn. Agr. Exp. Sta., Ann. Rept., 1896, p. 232.
2. Fla. Agr. Exp. Sta., Bul. 47, 1898, p. 51.

growth, such as the use of highly nitrogenous soil or too much water, is likely to cause hollow stem. He further found that quickly growing varieties are more likely to be affected, and that transplanting before hardening off the plants is favorable to the trouble. He advocates the use of less nitrogenous fertilizers, less crowding in the seed-beds and such conditions as will give rise to less rapid growth in the plants.

OEDEMA

This peculiar trouble of greenhouse tomatoes was first investigated by G. F. Atkinson[1] of Cornell University, who made an exhaustive study of it. He diagnoses the disease as follows:

"Oedema of the tomato is a swelling of certain parts of the plant brought about by an excess of water, which stretches the cell walls, making them very thin and the cells very large. The excess of water may be so great that the cell walls break down, and that part of the plant dying, exerts an injurious influence in adjacent parts."

The cause of Oedema is insufficient light, too much water in the soil and too high a moisture content of the air. It is an abnormal disease of very rare occurrence, and should cause no trouble if good judgment is exercised in growing the plants.

Oedema is easily produced by maintaining too moist an atmosphere and too high a soil temperature.

MOSAIC DISEASE

The so-called mosaic disease[2], which is common to tomatoes, is characterized by a peculiar yellow spotting of the upper surface of the leaves. These yellow spots, particularly when exposed to bright sunlight, subsequently become purplish in color, and the margins of the leaves curl up. We have observed many crops badly affected with what is termed "mosaic trouble," and in all cases this is associated with too extensive pruning. The more a tomato plant is pruned the more likely it is to be affected with the mosaic disease, and topping or pruning of the leaders induces this trouble more than other methods of pruning.

The mosaic disease is apparently a functional trouble, and little is known about it. Similar troubles are associated with tobacco (calico) and are believed to be infectious. The presence of this disease on tobacco is thought by some to be associated

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1. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bul. No. 53, 1893.
2. Bur. Plant Ind., U. S. Dept. Agr., A. F. Woods, Bul. No. 18.

with certain methods of transplanting. The disease on tomatoes does not destroy the foliage of the plant, but the abnormal metabolic processes which appear to be associated with this disease apparently affect the yield. A thorough study of this trouble is now being made in our greenhouse by Mr. G. H. Chapman,[1] and will be reported on later.

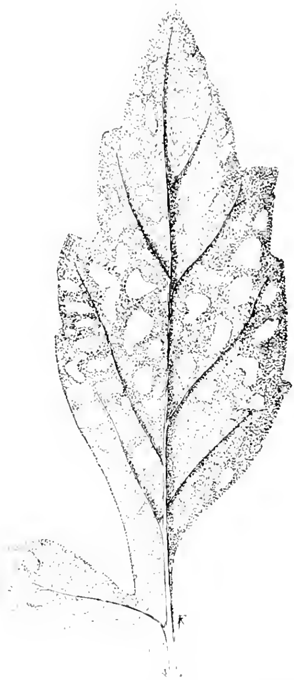

Fig. 9, showing the characteristic spotting due to mosaic disease of the tomato.

SOIL CONDITIONS FOR TOMATOES

The nature and conditions of the soil in which tomatoes are grown has much to do with the size of the crop and health of the plants. Plants grown in rich loam, of good texture, will develop a dark green color and luxuriant growth of foliage, whereas those grown in a poor soil will be light in color and spindling in appearance; moreover, feeble plants are much more susceptible to disease. We have repeatedly observed that the best crops are obtained the first year and that in succeeding years the crops

1. Mass. Agr. Exp. Sta., Ann. Rept., 1908, pp. 136—141.

decline when planted in the same soil: therefore it is advisable to change the soil occasionally.

A good soil for greenhouse tomatoes consists of one-third good loam, one-third pulverized sod, and one-third horse manure, although in some cases, especially where a good, rich light loam is available, the sod might be dispensed with. Frequent and liberal applications of horse manure, with decomposed sod applied occasionally will do much toward renovating a soil, but for the best results it is necessary to change the soil every few years or practice rotation.

GENERAL CONCLUSIONS IN REGARD TO GREENHOUSE DISEASES

Anyone who has given the matter of greenhouse diseases consideration is well aware that the more skill employed in growing a crop the less likelihood there is of its becoming diseased. Even a casual survey of some of the greenhouse establishments is sufficient to demonstrate this fact.

We know enough at the present time about the various kinds of blights, rots, mildews, etc., common to greenhouse plants to control them without syraying, and we know that if a crop is managed along certain lines diseases will cause little trouble or be entirely lacking. Spraying remedies, therefore, are not only of little use, but, on the other hand, prove positively harmful, since the gardener would not only be wasting his time on worthless methods, but his example would be putting a check on progress. The expert grower knows the conditions required by the plant and realizes the limitations of his crop. He knows that there is a limit to the amount of forcing which can safely be done, for too much forcing causes all sorts of troubles. He realizes that disease is intimately associated with environment, and that heat, light, moisture, etc., are very important factors in growing crops.

The plant, both in its chemical and physical characteristics, is affected by light, heat, electricity, soil and air moisture and biological relationships, and in the greenhouse by such factors as ventilation, air space, size and quality of glass—in fact, the simplest features connected with greenhouse construction. When the conditions surrounding the plant are far from the optimum, injury and even death result. A stimulus which may sometimes prove beneficial may injure or cause the death of the organism under other conditions, and it is only by meeting the optimum conditions for stimulation and the normal requirements of the plant that a perfect organism can be obtained. Therefore,

everything which has a bearing upon the development of the plant must be carefully considered if a perfect type is to be realized.

Even when it is not possible to modify the heat, light and moisture, as is the case out-of-doors, infection can be largely eliminated by making use of certain cultural practices.

Light affords a good illustration of the role a single factor may play in the configuration of plants. The physiological effect of light is to inhibit growth and to induce the formation of a firm texture of the tissue. Lack of light stimulates growth, but plants grown in darkness become etiolated and lack firmness of tissue. They have small leaves and elongated petioles, and the epidermal collenchymous and sclerenchymous tissues are undeveloped. There are many instances of the absence of light being responsible for serious troubles, while in other cases excess of light undoubtedly exerts a detrimental influence. The tonic influence of the Bordeaux mixture, brought about by favoring the formation of chlorophyll and carbon assimilation in many plants would appear to be due to the screening or lessening of the light intensity. Sun scald, which occurs on various trees, is brought about by excessive light, as in the case of apple trees, which, when defoliated by the gypsy moth, usually die from the effects of sun scald. On the other hand, shading often causes sun scald and winter killing by retarding the ripening of the wood.

In some cases too intense light or the conditions resulting from it, apparently causes trouble, at least in greenhouses. In the Northern latitudes many greenhouse crops do not obtain sufficient light during the winter months, and when cloudiness prevails it is with some difficulty that crops are matured without becoming diseased. All expert greenhouse men mature their crops when the weather conditions will permit, and not according to the calendar; in other words, it requires a certain definite amount of light, or so many light units, as it were, to mature a crop. The light in May, for example, is equal in intensity and amount to about twice that of corresponding periods of a day in November; consequently, it requires about twice as much time to bring a crop to the same degree of maturity in November as it would in May.

Lack of light is responsible for various mildews and leaf spots, top-burn or tip-burn, wilts, etc. Many of these leaf spots are seldom, if ever, found on plants to which sunlight has access. The Sclerotinia diseases of lettuce, water cress and parsley are likewise induced by crowding and shading, and light in such cases will prevent infection by the formation of resistant tissue. It is well known that absence of light causes the so-called "layering" of wheat and "damping off" of seedlings and cuttings, and the

mildews of various plants grown in the shade are too well known to need consideration. Since plants grow the most in the night, care must be taken to obtain a proper night temperature. Too high a night temperature accelerates growth and results in the formation of a more or less delicate tissue, and under the influence of bright sunshine wilting and often death results. Tissue formed at 45° F. is quite different from that formed at 50° F. as regards susceptibility to disease. The quality and size of glass and the other material used in greenhouse construction affects plant development, and some specific troubles can be traced directly to inferior construction. Crops grown in greenhouses from which 30% to 40% of the light is shut out will develop quite differently from those grown in houses where only 10% is shut out.

A serious wilt affecting cucumbers under glass is frequently observed, and affords a good illustration of trouble resulting from inferior greenhouse construction.

The regulation of atmospheric moisture is important in controlling many fungous diseases. Too much moisture in the house induces mildews and blights. Syringing the plants in bright sunshine, when the moisture on the foliage will dry off quickly, reduces the chances of infection, whereas when the moisture is allowed to remain on the foliage, as is the case when syringed at night, spore germination will take place and infection result. Diseases caused by Plasmopara, Alternaria and Anthracnose, common to cucumbers and melons in the field, may be completely controlled under glass if attention is given to the regulation of the moisture, and this is also true of tomato Cladosporium, cucumber mildew, chrysanthemum rust, and carnation rust to a large extent. The effect of atmospheric moisture is quite noticeable on outdoor blights, such as the oak Gloeosporium, asparagus rust, etc. Asparagus seldom, if ever, rusts when grown in the shade of trees, and oak Gloeosporium is usually confined to the sides of trees which are shaded.

The circulation of air also has a marked effect on the development of resistant tissue in greenhouse crops, and a lack of it is responsible for many leaf blights and rots. Even the hardiest of plants become sickly and succumb to the damping off fungus when grown in a stagnant atmosphere.

Too great a degree of soil heat and soil moisture causes serious troubles, as may be seen in the case of Oedema of tomatoes and the damping off of seedlings. An excess of moisture in the soil stimulates growth and often renders the plant more susceptible to disease.

An excess of water in the plant tissue is also favorable to

disease, as is shown by the susceptibility of certain plants to rust and mildew.

On the other hand, a lack of soil moisture induces weakness and renders the plants more susceptible to disease. An excess or insufficient amount of soil moisture causes prematurity and affects the life cycle of certain pathogenic organisms.

The stimulating effect of electricity, fertilizers, and sterilized soil often proves injurious by developing a too high water content in the tissue and rendering the plants more susceptible to disease. Sterilized soil has a stimulating effect on many crops, and if grown under ordinary temperatures they mature some weeks earlier than those grown in unsterilized soil. Such crops, however, are likely to be more or less flabby in appearance and generally contain a higher water content of the tissue than normally grown plants. Similar results are to be seen in connection with electrical stimulation.

An excess of nitrates in the soil inhibits root absorption and induces wilting, and in some cases causes malformations from on overabundance of plant food.

An unsuitable soil texture develops the plant abnormally and susceptibility to disease is increased. Tillage, irrigation, mulching, etc., are important factors in securing vigorous plants and exerting a beneficial influence as regards susceptibility.

While there are certain external factors associated with environment which induce pathological conditions in plants, in the majority of cases it so happens that more than one factor is concerned in bringing about this diseased condition, and similar abnormal conditions may be produced by different causes.

In conclusion, it may be said that in most cases, if not all, vital depressions are the real cause of disease. These are brought about by the abnormal conditions which modify and reduce the power of resistance, consequently the organism falls a prey to the ever-present germ.

CONCLUSIONS

Tomatoes are subject to various diseases, some of which are common to outdoor plants and others confined to those grown in greenhouses, and many affect crops grown under either condition.

The methods of treating outdoor crops necessarily differ from those required inside, since in the latter case the environment is more or less under control, and by proper control of the environment most of the diseases may be eliminated.

The principal diseases affecting outdoor tomatoes are the blossom end rot, tomato scab (Cladosporium), anthracnose

(Colletotrichum), leaf blight (Septoria), leaf blight (Cylindrosporium), leaf mold (Alternaria), bacterial blight, downy mildew (Phytophthora) and timber rot (Sclerotinia). The first six occur to a greater or less extent in Massachusetts, some of them occasionally causing considerable damage. The others have been noted elsewhere and have often proved troublesome.

For the present, spraying must be recommended for the treatment of outdoor tomato diseases, although in some cases it is of doubtful value, and the returns from the crop during certain seasons in some sections would warrant little expenditure in this direction. Proper training and pruning are beneficial and a sufficient water supply is of value in the control of the blossom end rot.

The principal diseases affecting greenhouse tomatoes are the blossom end rot, timber rot, scab (Cladosporium), eel worms, wilt, surface molds, burn or scald, hollow stem, Oedema and mosaic disease. Of these, the first four are the most important and can be absolutely controlled,—the blossom end rot by subirrigation, timber rot and eel worms by sterilizing the soil, and scab or Cladosporium by regulating the air moisture. The remaining ones are of little importance and as a rule result from abnormal conditions which should not be present.

The most important features in greenhouse culture are those connected with the management of the crop. Too great stress cannot be laid upon the necessity of the gardener's understanding the influence of such factors as heat, light, moisture, ventlation, etc. He should be careful about introducing radical changes in the management of the crop, and much discretion must be used in the application of fertilizers.

BULLETIN No. 139. OCTOBER 1911.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

INSPECTION OF COMMERCIAL FEED STUFFS

BY

P. H. SMITH and C. L. PERKINS.

This bulletin is published in accordance with the provisions of the Massachusetts feeding stuffs law. It contains a tabulation of the analyses of commercial feeding stuffs found offered for sale in the Massachusetts markets and presents a discussion of their relative values. In addition will be found a tabulated list of the wholesale cost of feeding stuffs from December to September of the present year.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

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AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, *Chemist.*

INSPECTION OF COMMERCIAL FEED STUFFS.

By P. H. Smith, *Chemist in Charge.*

Assisted by

C. L. Perkins and J. C. Reed.

INTRODUCTION.

This bulletin contains the analyses of 322 samples of commercial feeding stuffs collected in the open market by Mr. J. T. Howard, official inspector, during the winter and spring.

It is intended as an experiment beginning with this issue to publish the annual feeding stuffs bulletin in October or November rather than in February as formerly.

For the first time crude fiber determinations were made on all samples for the reason that it is believed to be just as important for the feeder to know whether he is buying an excessive amount of fiber in the form of oat hulls, ground corn cobs and other low grade by-products as to know the amount of protein he is purchasing. Owing to the lack of funds the analysis of wheat products was not made. These products, however, were given a cursory examination to determine if adulteration was being attempted. Beyond the fact that some samples contained rather more added screenings than should be found in a first-class wheat feed, no adulteration was found. Other feeds collected by the inspector but not analyzed were a considerable number of chick and scratching grains. These feeds, consisting as they do largely of whole or cracked grains, can be readily examined by the purchaser and the presence of an excessive amount of weed seeds, grit or other undesirable material easily detected.

Massachusetts was the pioneer state in feed control inspection. The law as originally drafted in 1896 simply provided for inspection and for the publication of results. Not anything was obligatory on the part of manufacturers and inspectors were simply allowed access to places where feed stuffs were stored or offered for sale,

with the privilege of taking samples. In 1902 the old law was repealed and the present law substituted, requiring that all feeding stuffs sold or offered for sale in Massachusetts should have affixed to each package in a conspicuous place the following information:

1. Name and address of the manufacturer or person responsible for placing the commodity on the market.

2. The net weight of the contents of the package.

3. The guaranteed minimum percentage of crude protein and of crude fat that the feeding stuff contains.

4. In case of adulteration the name of the foreign substance must be plainly printed upon each sack or parcel.

The feeding stuffs exempted from the provisions of the act are hays and straws, the whole seeds and unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn, wheat bran, wheat middlings, wheat mixed feed. Whole grains when ground together and unmixed with other substances are also exempt.

Profiting by the experience of the pioneer states, other states have now enacted superior control laws. It is felt that the Massachusetts law should be revised and brought up to date. It is intended to present a new law to the next session of the legislature for their consideration which will embody the following additional features:

1. *Revenue.* An increase of revenue for the more satisfactory execution of the law.

2. *Fiber.* In addition to the guaranteed minimum per cent of protein and fat, the maximum fiber guarantee will be asked for. Protein and fiber are a much better index for determining the value of a feeding stuff than protein and fat.

3. *A statement of the ingredients contained in mixed or compounded feeds.* The fiber guarantee and statement of ingredients are included in the requirements of all of the more recently enacted laws and, in fact, many feed stuffs manufactured in other states and found on sale in Massachusetts have tags attached which give this information.

How much grain does the purchaser get for one hundred pounds? A large number of manufacturers make a practice of including the sack in the net weight of the package. This makes a

shortage in feed of from 15 to 20 pounds a ton. With feed at $1.50 a hundred at retail, one is thus losing from 23 to 30 cents a ton. Many lots of feed show evidence of careless weighing, some sacks weighing over and some under 100 pounds net. A few jobbers and manufacturers are giving 100 pounds net. The consumer is entitled to what he pays for and in purchasing, preference should be given to those brands of feed that hold out in weight.

Many manufacturers in guaranteeing feed stuffs make use of a minimum and maximum statement. For example, a certain brand will be guaranteed to contain 15 to 20 per cent protein, 4 to 6 per cent fat and 8 to 12 per cent fiber. Such a practice tends to mislead the purchaser. Feeds should be purchased on the basis of the minimum amount of protein and fat and the maximum amount of fiber stated.

CHEMICAL ANALYSIS OF FEED STUFFS.

1911 [*Winter and Spring.*]

I. Protein Feeds.

COTTONSEED MEAL

Definitions. *COTTONSEED MEAL is the ground residue obtained in the extraction of oil from the cottonseed kernel.
CHOICE cottonseed meal contains at least 41 per cent protein.
PRIME cottonseed meal contains from 38.5 to 41 per cent protein.
GOOD cottonseed meal contains from 36 to 38.5 per cent protein.
COTTONSEED FEED is a mixture of cottonseed meal and cottonseed hulls containing less than 36 per cent protein.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Fiber.	
			Found.	Guar.	Found.	Guar.	Found.	Guar.
Choice.			%	%	%	%	%	%
American Cotton Oil Co., New York.								
Prime,	A. F. Knight & Co.	Hudson	40.72	38.61	8.23	8.00	7.97	11.50
F. W. Brode, Memphis, Tenn.								
Owl,	Blood Bros.	Medfield	41.91	41.00	7.53	6.00	6.68	10.00
Owl,	J. Paull & Co	Taunton	41.75	41.00	7.39	6.00	6.71	10.00
Buckeye Cotton Oil Co., Cincinnati, Ohio.								
Buckeye,	C. A. Pierce	Hinsdale	41.05	39.00	8.11	6.50	7.56	10.00
T. H. Bunch Co., Little Rock, Ark.								
Old Gold,	C. H. Smith	Dighton	43.11	41.00	8.04	9.00	6.55	—
Old Gold,	C. B. Sawin & Son	Southboro	41.73	41.00	7.85	9.00	7.61	—
Old Gold,	J. B. Garland & Son	Worcester	42.94	41.00	9.08	9.00	5.85	—
Chapin & Co., Boston, Mass.								
Green Diamond,	Berkshire Coal & Gr. Co.	No. Adams	42.29	41.00	7.74	8.00	7.00	—
S. P. Davis, Little Rock, Ark.								
Good Luck,	D. N. Foskitt	Brimfield	42.06	41.00	8.77	7.00	6.93	—
J. B. Garland & Son, Worcester, Mass.								
Golden Eagle,	S. B. Garland & Son	Worcester	41.25	41.00	8.72	9.00	6.94	—
Kemper Mill & Elevator Co., Kansas City, Mo.								
	McKenzie & Winslow	Fall River	45.27	41.00	9.91	7.50	4.46	—
F. E. Morse & Co., Little Rock, Ark.								
Golden,	Ropes Bros	Danvers	44.76	41.00	6.31	9.00	8.68	—
National Feed Co., St. Louis, Mo.								
Prime,	S. L. Davenport	N. Grafton	41.87	41.00	10.83	7.50	7.07	14.00
Prime,	D. H. Craig	Plymouth	42.91	41.00	8.69	7.50	6.46	14.00
J. E. Soper & Co., Boston, Mass.								
	Knight Grain Co.	Newburyport	41.92	41.00	8.48	8.00	6.39	—
	Highest		45.27	—	10.83	—	8.68	—
	Lowest		40.72	—	6.31	—	4.46	—
	Average		42.37	—	8.38	—	6.86	—

*Definitions used in connection with these tables merely indicate our basis of classification. In so far as possible they are based on trade usage, and are subject to future change and revision.

COTTONSEED MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Prime.							
American Cotton Oil Co., New York.							
W. L. Palmer	Medway	39.69	38.61	7.82	8.00	9.05	11.50
F. W. Brode & Co., Memphis, Tenn.							
Dove, A. Dodge & Sons	Beverly	38.81	38.00	11.04	7.00	8.73	10.00
Dove, I. J. Rowell	Pepperell	40.37	38.00	8.49	7.00	6.91	10.00
T. H. Bunch Co., Little Rock, Ark.							
Old Gold, F. Diehl & Son	Wellesley	40.61	41.00	8.11	9.00	6.69	—
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
Buckeye, Evans & Bowker	Baldwinsville	39.69	39.00	8.31	8.00	8.20	10.00
Buckeye, J. W. Doon & Son	Natick	39.56	39.00	7.99	6.50	8.46	10.00
S. P. Davis, Little Rock, Ark.							
Good Luck, C. P. McLanathan	Barre Plains	39.25	41.00	6.77	7.00	6.77	10.50
Florida Cotton Oil Co., Jacksonville, Fla.							
C. H. Symmes	Winchester	39.44	38.52	8.14	7.00	7.95	—
Humphreys, Godwin & Co., Memphis, Tenn.							
Dixie, F. M. Arnold	Southwick	39.79	41.00	8.61	8.00	9.05	12.00
Dixie, P. Foisy	New Bedford	40.06	38.62	6.86	6.00	9.24	12.00
Dixie, Morse Bros	Southbridge	40.14	38.50	8.06	6.00	8.27	13.00
J. E. Soper Co., Boston, Mass.							
*Choice, McKenzie & Winslow	Fall River	39.08	41.00	7.99	8.00	10.90	—
*Choice Milford Grain Co	Milford	39.38	41.00	7.92	8.00	9.51	—
*Choice, Warren Grain Co	Warren	39.28	41.00	7.58	8.00	10.03	—
J. Lindsay Wells Co., Memphis, Tenn.							
Red Star, Rollstone Grain Co	Fitchburg	40.21	38.50	7.43	6.00	8.27	11.00
Highest		40.61	—	11.04	—	10.90	—
Lowest		38.81	—	6.77	—	6.69	—
Average		39.69	—	8.07	—	8.54	—
Cottonseed Feed.							
Florida Cotton Oil Co., Jacksonville, Fla.							
Durham, A. M. Haggart	Franklin	23.91	24.46	6.21	7.00	17.91	—

*Misbranded choice.

LINSEED MEAL.

Definition. Linseed meal is the ground residue obtained in the extraction of oil from flaxseed.

Manufacturer or Jobber, Brand or Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
1. New Process.		%	%	%	%	%	%
American Linseed Co., New York.							
Cleveland Flaxmeal, C. B. Sawin & Son	Southboro	39.17	36.00	2.50	1.00	7.85	7.50
F. Diehl & Son	Wellesley	40.72	36.00	2.89	1.00	6.54	7.50
2. Old Process.							
American Linseed Co., New York.							
Dennison Plummer Co.	New Bedford	38.00	32.00	5.54	5.00	6.78	11.00
Kelloggs & Miller, Amsterdam, N. Y.							
A. D. Potter	Orange	37.68	33.00	6.83	5.00	6.88	7.40
H. B. Howland	Spencer	38.07	33.00	7.18	5.00	6.76	7.50
Guy G. Major Co., Toledo, Ohio.							
Hingham Grain Mill	Hingham	36.46	30.00	6.18	5.00	7.73	10.00
Bryant & Soule	Middleboro	29.99	30.00	6.37	5.00	8.70	10.00
Morse Bros	Southbridge	34.63	30.00	6.94	5.00	6.70	10.00
Mann Bros. Co., Buffalo, N. Y.							
A. Dodge & Sons	Beverly	38.21	34.00	6.80	6.00	6.99	10.00
Midland Linseed Co., Minneapolis, Minn.							
W. Lord	Athol	38.21	32.00	6.33	6.00	6.53	8.50
Average		37.11	—	5.76	—	7.15	—

GLUTEN FEED.

Definition. Gluten feed is a product obtained in the manufacture of starch and glucose from corn, and consists largely of the flinty portion of the kernel and corn bran.

Manufacturer or Jobber, Brand or Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber Found.	Fiber Guar.
American Maize Products Co., New York.							
Cream of Corn, G. M. Foster	Lowell	25.74	23.00	2.38	2.50	6.46	8.50
Cream of Corn, Brown Bros.	Northbridge	28.25	23.00	3.21	2.50	5.71	8.50
Corn Products Refining Co., New York.							
Buffalo, F. A. Fales & Co.	Norwood	28.00	23.00	2.33	2.50	7.85	8.50
Buffalo, I. J. Rowell	Pepperell	28.57	23.00	1.97	2.50	5.79	8.50
Buffalo, I. Morton & Co.	Plymouth	26.53	24.00	2.97	2.50	6.08	8.50
Buffalo, Curley Bros	Wakefield	25.63	23.00	4.05	2.50	6.63	8.50
Buffalo, S. B. Green & Co.	Watertown	25.77	24.00	3.69	2.50	6.08	8.50
Buffalo, Prentiss Brooks & Co.	Westfield	25.87	24.00	3.53	2.50	5.96	8.50
Crescent, McKenzie & Winslow	Fall River	25.17	23.00	2.67	2.50	6.85	8.50
Huron Milling Co., Harbor Beach, Mich.							
Jenks, J. Burkhardt	Beverly	23.51	23.00	5.66	3.00	5.95	5.00
J. E. Soper & Co., Boston, Mass.							
Bay State, Rollstone Grain Co.	Fitchburg	20.47	22.00	4.40	4.00	7.31	8.00
Highest		28.57	—	5.66	—	7.85	—
Lowest		20.47	—	1.97	—	5.71	—
Average		25.77	—	3.35	—	6.42	—

DISTILLERS' DRIED GRAINS.

Definition. Distillers' dried grains are the dried residue obtained from cereals in the manufacture of alcohol and distilled liquors.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Fiber.	
			Found.	Guar.	Found.	Guar.	Found.	Guar.
			%	%	%	%	%	%
Ajax Milling & Feed Co., Buffalo, N. Y.								
Ajax Flakes,	C. S. Barber	Bernardston	29.89	30.00	12.10	10.00	9.80	14.00
Ajax Flakes,	Eastern Grain Co.	Bridgewater	30.08	30.00	11.74	11.00	12.14	14.00
J. W. Biles Co., Cincinnati, Ohio.								
Fourex,	F. F. Woodward & Co.	Fitchburg	30.59	31.00	11.51	12.00	12.83	13.00
Fourex,	Cutler Grain Co.	S. Framingham	30.86	31.00	11.66	12.00	12.54	13.00
Fourex,	P. W. Eaton & Co.	Williamstown	29.20	31.00	11.61	12.00	13.47	13.00
Continental Cereal Co., Peoria, Ill.								
Continental,	Potter Grain Co.	Shelburne Falls	30.91	33.00	12.20	14.00	7.60	—
Dewey Bros. Co., Blanchester, Ohio.								
Buckeye,	R. W. Davies	Greenfield	21.10	20.00	3.78	5.00	12.05	15.00
Hottelet Co., Milwaukee, Wis.								
Rye Grains,	J. Burkhardt	Beverly	17.20	16.00	5.97	8.00	12.53	14.00
Rye Grains,	W. G. Horton	Ipswich	12.87	16.00	6.90	8.00	16.06	14.00
Rye Grains,	Lexington Grain Co.	Lexington	15.54	16.00	7.19	6.00	13.35	14.00
Husted Milling Co., Buffalo, N. Y.								
	C. F. Pease	Chester	29.59	30.00	12.06	8.00	9.78	11.00
Marlboro Grain Co., Marlboro.								
	Marlboro Grain Co.	Marlboro	15.50	18.00	7.93	4.00	14.20	15.00

MALT SPROUTS.

Definition. Malt sprouts consist of the dried sprouts of the barley grain removed after the process of malting.

American Malting Co., Buffalo, N. Y.								
	Lummus & Parker	Danversport	25.61	25.00	0.94	2.00	14.15	10.00
	S. L. Davenport & Son	N. Grafton	28.00	25.00	0.80	2.00	12.39	10.00
Francis Duhne Jr., Milwaukee, Wis.								
	E. A. Cowee	Worcester	23.97	25.00	0.89	2.00	13.68	11.00
	J. B. Garland & Son	Worcester	31.04	25.00	1.30	2.00	11.39	11.00
D. W. Ranlet Co., Boston, Mass.								
	Ropes Bros.	Salem	22.10	23.00	1.10	1.00	13.30	-
	Average		26.14	—	1.01	—	12.98	-

BREWERS' DRIED GRAINS.

Definition. Brewers' dried grains are the dried residue obtained from cereals in the manufacture of malted liquors.

James Hanley Brewing Co., Providence, R. I.								
	H. A. Crossman Co.	Needham	25.54	20.00	6.77	7.00	15.35	—

DAIRY FEEDS.

Definition. Dairy feeds are proprietary feeds consisting of a mixture of several feeding stuffs and containing 15 or more per cent protein.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Fiber.	
			Found.	Guar.	Found.	Guar.	Found.	Guar.
			%	%	%	%	%	%
J. Bibby & Sons, Liverpool, Eng.								
Oilcake Feed,	J. Loring & Co	Watertown	20.63	16.00	6.84	7.00	8.93	—
J. W. Biles Co., Cincinnati, Ohio.								
Union Grains,	Marlboro Grain Co	Marlboro	23.97	24.00	6.53	7.00	9.18	9.00
Union Grains,	Hathaway&McKenzieCo	New Bedford	25.13	24.00	7.04	7.00	9.58	9.00
Union Grains,	H. W. Miller	Pittsfield	25.48	24.00	6.39	7.00	9.23	9.00
Buffalo Cereal Co., Buffalo, N. Y.								
Creamery Feed,	J. H. Nye	Brockton	20.26	18.00	5.43	4.00	10.35	8.00
Creamery Feed,	A. Culver Co	Rockland	19.65	18.00	5.70	4.00	9.75	8.00
Chapin & Co., Boston, Mass.								
Unicorn,	J. H. Nye	Brockton	26.60	26.00	6.08	5.50	8.80	10.00
Unicorn,	C. Bond	Charlton	25.22	26.00	6.73	5.50	9.00	10.00
Unicorn,	E. J. Adams	Gt. Barrington	27.12	26.00	6.39	5.50	8.87	10.00
Unicorn,	Haverhill Milling Co	Haverhill	25.70	26.00	6.78	5.50	8.80	10.00
Unicorn,	W. N. Potter Grain Co.	Princeton	25.70	26.00	6.44	5.50	9.61	10.00
H. O. Co. Mills, Buffalo, N. Y.								
Algrane,	Lenox Coal Co	Lenoxdale	14.54	14.00	4.82	4.00	10.36	9.00
Northwest Mills Co., Winona, Minn.								
Sugarota Milk Meal,	J. H. Nye	Brockton	24.96	25.00	3.39	6.00	11.38	9.00
Sugarota Milk Meal,	H. K. Webster Co.	Lawrence	25.52	25.00	3.63	6.00	10.54	9.00
Quaker Oats Co., Chicago, Ill.								
Blue Ribbon,	R. W. Davies	Greenfield	26.79	25.00	4.81	4.50	11.42	8.00
Blue Ribbon.	Worcester Hay & Gr. Co	Worcester	27.00	25.00	3.87	4.50	9.43	8.00
St. Albans Grain Co., St. Albans, Vt.								
Wirthmore,	C. Bond	Charlton	24.34	26.00	5.21	5.00	8.81	—
Wirthmore,	F. Gauvin, Jr	Marlboro	25.72	26.00	5.26	5.00	8.28	—
Wirthmore,	P. Foisy	New Bedford	25.42	26.00	5.58	5.00	8.24	—

MOLASSES FEEDS.

Definition. Molasses feeds are mixtures of molasses, low grade milling offal and high grade feeding stuffs.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber Found.	Fiber Guar.
American Milling Co., Chicago, Ill.								
Sucrene Dairy,	McKenzie & Winslow	Fall River	16.54	16.50	4.48	3.50	12.98	12.00
Sucrene Dairy,	Marlboro Grain Co.	Marlboro	15.25	16.50	3.90	3.50	12.62	12.00
Sucrene Dairy,	Milford Grain Co.	Milford	15.93	16.50	3.75	3.50	12.00	12.00
F. W. Dorr & Co., Newton Center, Mass.								
Harvard,	F. W. Dorr & Co.	Newton Center	20.42	18.00	4.07	4.00	7.03	9.00
Great Western Cereal Co., Chicago, Ill.								
Daisy,	McKenzie & Winslow	Fall River	19.00	15.00	2.16	3.00	13.51	12.00
Daisy,	Marlboro Grain Co.	Marlboro	15.80	15.00	2.33	3.00	14.90	12.00

MOLASSES FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Husted Milling Co., Buffalo, N. Y.							
W. G. Horton	Ipswich	21.15	18.00	4.42	4.00	7.22	9.00
W. L. Palmer,	Medway	19.63	18.00	3.65	4.00	7.74	9.00
Robinson & Jones	Natick	19.97	18.00	5.10	4.00	6.96	9.00
Chas. A. Krause Milling Co., Milwaukee, Wis.							
Badger, ... Jaquith & Co.	Woburn	17.14	16.00	1.35	1.25	15.70	15.00
Northwest Mills Co., Winona, Minn.							
Sugarota Dairy, ... Evans & Bowker	Baldwinsville	16.30	16.00	3.99	3.00	16.05	15.00
Sugarota Dairy, ... G. C. Turner	Chester	17.33	16.50	3.70	3.50	14.62	14.00
Sugarota Dairy, ... McKenzie & Winslow	Fall River	17.58	16.50	4.59	3.50	12.76	14.00
Sugarota Dairy, ... W. N. Potter Grain Co.	Princeton	16.62	16.50	4.10	3.50	15.77	14.00
Quaker Oats Co., Chicago, Ill.							
Quaker Dairy, ... S. B. Green & Co.	Watertown	15.50	16.00	4.45	3.50	16.04	12.00
Western Grain Products Co., Hammond, Ind.							
Hammond, ... Berkshire Coal & Gr. Co.	N. Adams	17.14	17.00	4.12	3.00	10.70	10.00

RYE FEEDS.

Definition. Rye feeds are by-products obtained in the manufacture of flour from rye.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Boutwell Milling & Grain Co., Troy, N. Y.							
A. T. Butler	Adams	14.89	13.50	3.05	3.00	3.70	—
Geo. T. Callahan, Castleton, N. Y.							
G. C. Turner	Chester	12.31	12.00	2.39	2.00	2.73	—

CALF MEAL.

Definition. Calf meal is a proprietary mixture intended as a feed for young calves.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
J. Bibby & Sons, Liverpool, Eng.							
Cream Equivalent, ... J. Loring & Co.	Watertown	15.28	14.00	13.57	14.00	4.52	—
Blatchford's Calf Meal Factory, Waukegan, Ill.							
Blatchford's, ... W. L. Palmer	Medway	25.94	25.00	6.31	5.00	6.93	—
Blatchford's, ... C. L. Beals & Co.	Winchendon	25.08	25.00	5.42	5.00	5.70	—
Great Western Cereal Co., Chicago, Ill.							
Gregson, ... G. F. Wetherbee Co.	Gardner	28.02	25.00	6.70	5.00	4.73	5.00
Northwest Mills Co., Winona, Minn.							
Sugarota, ... Brown Bros.	Northbridge	26.82	25.00	6.52	6.00	4.49	—

MISCELLANEOUS PROTEIN FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
J. Bibby & Sons, Liverpool, England.							
Pig Meal, ... J. Loring & Co.	Watertown	13.29	13.00	5.77	6.00	7.41	—
Oil Cake for Horses, . J. Loring & Co.	Watertown	18.48	16.00	7.69	7.00	8.61	—
Chas. A. Krause Milling Co., Milwaukee, Wis.							
Maizo Oil Meal, ... Jaquith & Co.	Woburn	13.58	16.00	9.00	8.00	5.13	5.00
Ropes Bros., Danvers.							
Horse Feed, ... Ropes Bros.	Danvers	15.36	16.00	5.94	5.00	8.35	—

II. STARCHY (CARBOHYDRATE) FEEDS.

CORN MEAL.

Manufacturer or Jobber, Brand or Retailer.	Sampled at:	Water.	Protein.		Fat.		Fiber.	
			Found.	Guar.	Found.	Guar.	Found.	Guar.
Ground by Retailer.		%	%	%	%	%	%	%
C. Bond	Charlton	18.97	7.98	—	3.49	—	1.81	—
E. E. Cole	Billerica	20.54	7.95	—	3.00	—	2.47	—
F. A. Fales & Co.	Norwood	20.07	8.67	—	3.21	—	2.12	—
D. W. Foskett	Brimfield	20.71	8.36	—	3.38	—	1.68	—
Hingham Grain Mill Co	Hingham	23.95	8.00	—	2.94	—	1.44	
D. F. Howard	Ware	20.99	8.95	—	2.58	—	1.46	—
Bolted, E. C. Packard	Brockton	16.75	8.99	—	2.75	—	1.09	—
Scott Grain Co.	Amesbury	21.33	7.99	—	2.61	—	1.00	—
Warren Grain Co.	Warren	18.13	7.98	—	3.47	—	1.67	—
J. Cushing & Co., Fitchburg, Mass. C. H. Smith	Dighton	20.60	7.53	—	2.72	—	2.02	—
Cutler Co., North Wilbraham, Mass. Thorne Bros	Millis	20.62	8.55	—	2.14	—	1.90	—
J. O. Ellison & Co., Haverhill, Mass. Preble Bros.	Merrimac	19.78	8.35	—	3.68	—	1.81	—
Elmore Milling Co., Oneonta, N. Y. A. D. Potter	Orange	22.92	8.14	—	3.08	—	1.75	—
Husted Milling Co., Buffalo, N. Y. F. H. Crane & Sons	Quincy Adams	19.30	7.47	—	1.00	—	0.64	—
W. Parlett	Lee	18.39	7.22	—	1.65	—	0.64	—
Mansfield Milling Co., Mansfield, Mass. Bliss & Co.	Taunton	20.11	8.27	—	3.10	—	1.79	—
Molett Grain Co., McClure, Ohio. AAA, Robinson & Jones Co.	Natick	18.02	8.25	—	2.19	—	1.09	—
Narragansett Milling Co., E. Providence, R. I. G. S. Drake	W. Bridgewater	20.05	8.23	—	1.97	—	1.89	—
Smith, Northam & Co., Hartford, Conn. J. F. Shine	Dedham	21.00	8.29	—	3.60	—	1.81	—
Highest		22.92	8.99	—	3.68	—	2.47	—
Lowest,		16.75	7.22	—	1.00	—	0.64	—
Average,		20.12	8.17	—	2.77	—	1.58	—

GROUND OATS.

Manufacturer or Jobber, Brand or Retailer.	Sampled at:	Water.	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber Found.	Fiber Guar.
Ground by Retailer.								
E. A. Cole	Housatonic	—	12.82	—	5.21	—	7.49	—
F. A. Fales & Co.	Norwood	—	11.47	—	3.65	—	8.40	—
Whole Oats, W. G. Horton	Ipswich	—	12.43	—	5.33	—	8.53	—
E. C. Packard	Brockton	—	13.04	—	4.85	—	9.38	—
Ropes Bros.	Salem	—	12.69	—	5.52	—	8.01	—
E. A. Cowee, Worcester, Mass. I. J. Rowell	Pepperell	—	11.59	—	4.46	—	9.48	—
Husted Milling Co., Buffalo, N. Y. Brockelman Bros.	Clinton	—	11.82	—	4.94	—	9.81	—
Average		—	12.27	—	4.85	—	8.73	—

RYE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
J. Cushing & Co., Fitchburg, Mass.							
G. F. Wetherbee & Co.	Gardner	9.73	—	1.87	—	1.72	—
E. C. Packard, Brockton.							
E. C. Packard	Brockton	12.17	—	1.91	—	1.71	—
Nathan Tufts & Son, Charlestown, Mass.							
Bunker Hill, I. Morton & Co	Plymouth	10.51	—	1.72	—	1.74	—

HOMINY MEAL.

Definition. Hominy meal, feed or chop is a by-product in the manufacture of hominy grits from corn, and consists of the hull and corn germ together with a considerable portion of the corn starch.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
American Hominy Co., Indianapolis, Ind.							
Homco, G. F. Wetherbee Co.	Gardner	10.01	9.50	7.31	7.00	4.08	7.00
Homco, C. A. Pierce	Hinsdale	10.63	9.50	7.38	7.00	4.26	7.00
Buffalo Cereal Co., Buffalo, N. Y.							
Wm. Baylies	New Bedford	9.52	10.00	7.08	7.00	3.16	4.00
W. N. Potter Grain Co.	Princeton	10.17	10.00	7.67	7.00	3.35	4.00
Chas. M. Cox Co., Boston, Mass.							
Wirthmore, Eastern Grain Co	Bridgewater	11.10	9.50	8.17	7.50	3.91	—
Wirthmore, C. A. Pierce	Hinsdale	10.80	9.50	9.13	7.50	4.48	—
Wirthmore, G. H. Reed	So. Acton	9.41	9.50	7.45	7.50	3.70	—
Deutsch & Sickert Co., Milwaukee, Wis.							
Success, Warren Grain Co	Warren	12.26	11.00	6.16	7.00	5.48	4.00
Evans Milling Co., Indianapolis, Ind.							
J. A. Conners	Malden	12.91	10.00	6.95	8.00	4.78	7.00
Hunter Robinson Wenz Milling Co., St. Louis, Mo.							
Capital, Scott Grain Co	Amesbury	10.26	11.02	7.43	7.78	3.65	—
Capital, J. Shea	Lawrence	10.46	11.02	8.13	7.78	5.02	—
Capital, Morse Bros	Southbridge	10.42	11.02	8.52	7.78	4.32	9.85
Chas. A. Krause Milling Co., Milwaukee, Wis.							
Badger, J. O. Ellison & Co	Haverhill	10.80	10.00	8.23	8.00	4.61	5.00
H. E. McEachron Co., Wausau, Wis.							
M. H. Rolfe	Newburyport	11.31	11.25	10.42	8.50	4.04	4.00
Miner-Hillard Milling Co., Wilkes-Barre, Pa.							
McKenzie & Winslow	Fall River	10.51	10.00	8.31	7.50	3.20	5.00
Worcester Hay & Grain Co.	Worcester	10.20	10.00	6.92	7.50	2.66	5.00
Patent Cereals Co., Geneva, N. Y.							
W. S. Harrington	Adams	10.16	10.00	7.47	7.00	3.39	5.00
F. F. Woodward & Co.	Fitchburg	9.76	10.00	7.73	7.00	3.19	5.00
Patrons Coop Association	Lowell	10.72	10.00	8.10	7.00	4.12	5.00

*Contains ground corn cob, not included in average.

HOMINY MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
			%	%	%	%	%	%
Standard Cereal Co., Chillicothe, Ohio.								
Standco,	Ropes Bros.	Salem	9.46	11.50	5.91	3.00	1.14	4.00
Suffern, Hunt & Co., Decatur, Ill.								
Acme,	F. Knight	Charlton	10.75	9.30	8.68	7.10	4.29	10.00
Toledo Elevator Co., Toledo, Ohio.								
*Star Feed,	Haverhill Milling Co.	Haverhill	8.32	7.00	5.50	5.50	10.36	12.50
*Star Feed,	E. E. McCauslin	Lowell	8.49	7.00	6.74	5.50	10.41	12.50
	Highest		12.91	—	10.42	—	5.48	—
	Lowest		9.41	—	5.91	—	1.14	—
	Average		10.55	—	7.79	—	3.87	—

PROVENDER.

Definition. Provender is a mixture of straight corn and oats ground together.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Water.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Ground by Retailer.									
	C. Bond	Charlton	16.13	9.72	—	3.79	—	4.98	—
	E. A. Cole	Housatonic	17.48	10.22	—	3.90	—	4.97	—
	J. B. Cover & Co.	Lowell	14.14	9.29	—	3.82	—	3.87	—
	A. Culver Co.	Rockland	15.15	9.34	—	3.96	—	3.94	—
	H. Houghton	Millbury	17.33	9.37	—	3.55	—	3.31	—
	D. F. Howard	Ware	16.20	10.17	—	3.78	—	5.36	—
	Warren Grain Co.	Warren	14.19	9.72	—	3.94	—	5.84	—
	M. G. Williams	Raynham	15.45	9.64	—	3.67	—	4.13	—
	F. F. Woodward	Fitchburg	11.98	9.50	—	3.99	—	4.38	—
E. A. Cowee, Worcester, Mass.									
No. 1,	I. J. Rowell	Pepperell	16.43	9.72	9.00	3.07	3.00	3.65	—
Husted Milling Co., Buffalo, N. Y.									
1-2 & 1-2	Brockelman Bros.	Clinton	16.57	8.45	—	3.55	—	3.85	—
1-2 & 1-2,	Lenox Coal Co.	Lenoxdale	16.23	9.29	—	4.52	—	3.39	—
Corn and Oats,	A. M. Haggart	Franklin	16.32	8.74	9.00	3.27	4.00	3.05	—
Yellow Provender,	A. M. Haggart	Franklin	17.00	7.44	7.00	2.71	4.00	4.90	—
Imperial Grain & Milling Co., Toledo, O.									
Imperial,	McKenzie & Winslow	Fall River	—	9.65	10.00	4.05	4.50	3.25	5.00
Imperial,	C. W. Bowker & Co.	Worcester	—	9.19	10.00	4.72	4.00	2.93	5.00
Mollet Grain Co., McClure, Ohio.									
Corn and oat chop,	W. Parlett	Lee	—	9.82	10.00	4.37	4.00	2.90	9.00
Smith, Northam & Co., Hartford, Conn.									
	J. F. Ray	Franklin	19.15	9.25	9.00	4.33	4.00	4.46	—
	Highest		19.15	10.22	—	4.72	—	5.84	—
	Lowest		11.98	8.45	—	2.71	—	2.90	—
	Average		15.99	9.36	—	3.83	—	4.09	—

CORN AND OAT FEEDS.

Definition. Corn and oat feeds are proprietary mixtures consisting largely of oat by-products and corn and contain less than 12 per cent protein, and usually from 8 to 15 per cent of fiber.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Water.	Protein.		Fat.		Fiber.	
				Found.	Guar.	Found.	Guar.	Found.	Guar.
				%	%	%	%	%	%
Amendt Milling Co., Monroe, Mich.									
Amco,	Rollstone Grain Co.	Fitchburg	—	7.71	7.87	3.85	3 82	7.47	10.95
William C. Brett, North Abington, Mass.									
All Right,	W. C. Brett	N. Abington	—	9.24	9.00	5.33	4.00	6 91	—
A. H. Brown & Bros., Boston, Mass.									
Queen,	Weld & Beck	Southbridge	—	8.96	10.00	5.68	4.00	9.70	-
Chapin & Co., Boston, Mass.									
Pearl,	A. W. Whittemore	Worcester	—	8 67	7.00	4 49	4 00	5 79	9.70
Chas. M. Cox Co., Boston, Mass.									
Wirthmore,	Hoosac Val Coal & Gr Co	Adams	—	10.11	9.00	6.12	4 00	7.59	—
J. Cushing & Co., Hudson, Mass.									
Hudson,	J. Cushing & Co	Hudson	—	9.02	10.00	6.13	4.00	8 14	—
Detroit Milling Co., Detroit, Mich.									
Adrian,	W. P. Barney	Seekonk	—	7.44	9.50	3.07	5.00	8 45	8.00
F. W. Dorr Co., Newton Center, Mass.									
Matchless.	F. W. Dorr Co.	Newton Center	—	9.72	8.50	6.99	4 50	7.86	—
Empire Mills, Olean, N. Y.									
XX Empire,	P. Foisy	New Bedford	—	8.28	7 63	4.38	3.97	6.58	—
J. B. Garland & Son, Worcester, Mass.									
Red Tag A,	H. Houghton	Millbury	—	10.16	12.00	4.90	3.50	10 36	—
Red Tag A,	J. B. Garland & Son.	Worcester	—	11.50	7.00	4.65	3.00	11.13	—
Red Tag B,	Brown Bros.	Northbridge	—	10.24	10.00	4.87	3.25	8.90	—
Red Tag B,	J. B. Garland & Son.	Worcester	—	9.93	7.00	5.43	3.00	11.00	—
Great Western Cereal Co., Chicago, Ill.									
Boss,	G. F. Wetherbee Co.	Gardner	—	8.54	8.00	4.66	3.50	10.72	9 00
Sterling,	E. J. Adams	Gt. Barrington.	—	10.42	10.00	4.32	4.00	7.13	9.00
Sterling,	E. A. Cowee	Jefferson	—	9.98	10.00	3 50	4 00	7.60	8.00
W. H. Haskell & Co., Toledo, Ohio.									
Haskells,	Milford Gr Co.	Milford	—	9.46	8.00	7.31	4 00	6 74	6 00
Haskells,	Bliss & Co.	Taunton	—	9.06	8.00	7.00	4 00	7 07	8 00

CORN AND OAT FEEDS (Continued.)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
H. O. Mills, Buffalo, N. Y.							
Algrane Horse,.......G. F. Green Coal Co....	Campello......	10.12	12.00	4.38	4.50	9.68	9.00
Algrane Horse,.......S. L. Davenport & Son .	N. Grafton....	10.51	12.00	4.60	4.50	9.43	9.00
N. E. S. F.,.........S. L. Davenport & Son .	N. Grafton....	10.59	9.00	4.89	4.00	8.12	12.00
N. E. S. F.,.........Knight Grain Co.......	Newburyport .	9.81	9.00	5.83	4.00	12.85	12.00
Husted Milling Co., Buffalo, N. Y.							
Husted Stock,........W. C. Brett..........	N. Abington...	10.05	8.00	6.55	4.00	7.10	—
Imperial Grain and Milling Co., Toledo, Ohio.							
Corn, oat & barley chop H. K. Webster Co....	Lawrence......	8.58	8.90	3.20	3.70	12.33	11.75
Corn, oat & barley chop Mansfield Milling Co.	Mansfield.....	8.04	8.90	4.00	3.70	13.53	11.75
Corn, oat & barley chop W. Baylies	New Bedford .	10.68	8.90	4.03	3.70	14.07	11.75
Regal,..............Mansfield Milling Co...	Mansfield.....	7.18	8.00	2.90	3.50	13.96	12.75
Kornfalfa Feed Milling Co., Kansas City, Mo.							
*Kornfalfa,..........McKenzie & Winslow...	Fall River	10.97	12.00	2.61	4.00	12.22	11.00
*Kornfalfa,..........N. Adams Grain Co ...	N. Adams.....	10.19	11.00	3.69	4.00	10.94	12.00
Malden Grain Co., Malden, Mass.							
Excel,..............Malden Grain Co	Malden.......	9.52	10.00	2.84	3.00	8.50	—
Marshall Mackel Co., Boston, Mass.							
Uniform,...........Jaquith & Co..........	Woburn.......	8.39	7.00	4.23	3.00	5.81	—
Uniform,...........A. N. Whittemore	Worcester.....	9.19	7.00	4.37	3.00	5.64	
Meech & Stoddard Inc., Middletown, Conn.							
Korno-Oato,.........A. Milot & Son........	Taunton......	5.56	7.00	1.79	3.00	16.05	—
A. Milot & Son, Taunton, Mass.							
Milots,.............A. Milot & Son	Taunton......	8.93	—	3.19	—	5.57	—
Mollett Grain Co., Frankfort, Ky.							
Park City Chop,.....J. Shea................	Lawrence......	9.67	8.00	6.56	3.50	5.53	10.00
Park City Chop,.....Wm. Baylies...........	New Bedford .	9.28	8.00	7.47	3.50	7.03	10.00
Noyes & Colby, Boston, Mass.							
New Era,...........Rollstone Grain Co.....	Fitchburg.....	8.97	10.00	6.74	4.00	8.53	—
Quaker Oats Co., Chicago, Ill.							
Schumacher's,.......H. Houghton..........	Millbury......	10.84	10.00	3.63	3.50	9.35	10.00
Schumacher's,.......G. S. Drake...........	W. Bridgewater	10.59	10.00	3.58	3.25	9.21	10.00
Schumacher's Special W. C. Witcher........	Stoneham ..	9.14	9.25	3.96	3.25	8.60	8.00
Schumacher's Special, Wallace Grain Co	Clinton.......	9.54	9.25	4.08	3.25	7.13	8.00
Schumacher's Special, WorcesterHay&GrainCo.	Worcester. ...	9.37	9.25	3.61	3.25	7.12	8.00
Victor,.............Phillips Bates & Co.....	Hanover.......	8.41	7.50	4.42	3.00	10.95	12.00
Victor,.............A. F. Knight & Co.....	Hudson.......	7.15	7.50	3.19	3.00	10.81	12.00
White Diamond,.....Bedford Coal&GrainCo..	Bedford.......	7.95	8.00	3.30	3.25	6.71	9.00
G. H. Reed, South Acton, Mass.							
Acton's Best,.......G. H. Reed............	S. Acton......	9.15	10.00	6.30	4.00	8.43	—
Toledo Elevator Co., Toledo, Ohio.							
Hexagon,...........A. N. Whittemore	Worcester	8.41	6.00	5.03	5.00	12.47	10.00

*Corn, oats and alfalfa.

CORN AND OAT FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
H. K. Webster Co., Lawrence, Mass.							
Royal, ... H. K. Webster Co.	Lawrence......	8.02	6.00	4.39	2.00	12.85	—
Whitney Coal & Grain Co., N. Adams, Mass.							
Best, ... Whitney Coal & Grain Co.	N. Adams.....	8.89	10.00	6.22	4.00	8.95	—
F. F. Woodward & Co., Fitchburg, Mass.							
Very Best..... ... F. F. Woodward & Co..	Fitchburg	10.51	10.00	5.36	4.00	7.52	—

FORTIFIED STARCHY FEEDS.

Definition. Fortified starchy feeds are corn and oat feeds to which has been added one or more protein feeds in order to bring the protein content of the mixture to between **12** and **15** per cent protein.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber. Found.	Fiber. Guar.
Buffalo Cereal Co., Buffalo, N. Y.							
Horse, ... Griffen Bros.	Fall River.....	12.32	10.00	5.01	4.00	9.01	8.00
Lexington Grain Co., Lexington, Mass.							
GoodValueHorse Feed, Lexington Grain Co....	Lexington.....	12.85	9.00	5.53	3.00	6.39	—
Alfalfa Horse Feed, ... Lexington Grain Co...	Lexington	12.24	11.00	5.29	3.00	8.50	—
Purina Mills, St. Louis, Mo.							
Purina, ... Bowen & Fuller........	Leominster....	12.65	12.50	4.40	4.00	12.21	8.00

ADULTERATED WHEAT FEEDS.

Definition. Adulterated wheat feeds are wheat products to which has been added material derived from some other source than wheat.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber. Found.	Fiber. Guar.
Indiana Milling Co., Terre Haute, Ind.							
Holstein, ... McKenzie & Winslow...	Fall River.....	10.40	12.00	3.42	3.00	16.07	15.00
Holstein, .. Hathaway & McKenzie Grain Co.	New Bedford .	11.06	12.00	2.43	3.00	16.33	15.00
Jersey, ... A. Altman............	New Bedford .	9.40	12.00	2.73	3.00	14.13	15.00
Jersey, ... A. E. Gilbert	W. Brookfield .	10.68	12.00	3.17	3.00	16.34	15.00
Sterling, ... Wallace Grain Co......	Clinton.......	10.00	10.00	3.21	3.00	13.26	14.00
A. Waller & Co., Henderson, Ky.							
Blue Grass, ... E. A. Cowee...........	Jefferson......	11.51	9.00	3.05	2.00	15.10	15.00
Blue Grass, ... H. K. Webster Co......	Lawrence	9.68	9.00	2.65	2.00	14.90	15.00

DRIED BEET PULP.

Definition. Dried beet pulp is the dried sugar beet residue obtained in the manufacture of beet sugar.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber. Found.	Fiber. Guar.
Dominion Sugar Co., Wallaceburg, Ontario.							
A. Altman....	New Bedford..	7.55	—	0.84	—	16.61	—
Sprague & Williams.....	S. Framingham	7.58	8.00	0.73	0.50	17.65	20.00
German-American Sugar Co., Bay City, Mich.							
H. K. Webster Co......	Lawrence......	8.93	8.00	0.60	0.50	18.26	20.00
Owosso Sugar Co., Lansing, Mich.							
W. P. Barney..........	Seekonk.......	8.34	8.00	0.43	0.50	18.40	20.00
Rock County Sugar Co., Janesville, Wis.							
J. B. Garland & Son....	Worcester.....	11.56	8.00	0.40	0.50	18.31	20.00
Average.............	....	8.79	—	0.61	—	17.85	—

MISCELLANEOUS STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
A. H. Brown & Bros., Boston, Mass.							
*Dried Grains, ... H. A. Crossman Co. . . .	Needham	12.67	10.00	3.65	2.50	15.25	—
Chas. M. Cox Co., Boston, Mass.							
Oat Feed, ... J. B. Garland & Son	Worcester	5.32	5.75	2.30	2.50	25.90	26.00
A. R. Eales, Boston, Mass.							
**Molassine Meal, . I. Morton & Co.	Plymouth	9.26	7.00	0.52	0.50	6.33	—
Horton Milling Co., Ashtabula, Ohio.							
Buckwheat Feed, . . . J. Shea	Lawrence	12.87	12.70	3.02	2.63	29.47	34.21
Husted Milling Co., Buffalo, N. Y.							
***Germaline, ... A. Dodge & Sons	Beverly	8.64	9.00	4.10	3.00	1.11	—
Molasses Horse Feed, . A. M. Haggart	Franklin	10.99	7.00	4.31	3.00	4.49	15.00
Quaker Oats Co., Chicago, Ill.							
Flax Shives, ... H. W. Miller	Pittsfield	9.11	—	4.75	—	32.91	—

*Said to be by-product from the manufacture of Mellen's Food.
**Contained 21.82 % of water.
***Corn meal and molasses, contained 19.21 % of water.

III. POULTRY FEEDS.
MEAT SCRAPS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
First Grade (over 45 per cent Protein.)						
Butchers Rendering Co., Fall River, Mass.						
W. J. Meek	Fall River	54.38	40.00	12.40	10.00	20.98
Geo. E. Marsh Co., Lynn, Mass.						
A. Culver Co.	Rockland	45.57	45.00	13.10	10.00	30.43
N. E. Dressed Meat & Wool Co., Boston, Mass.						
Lexington Grain Co. . . .	Lexington	47.81	53.00	14.61	10.00	26.76
M. L. Shoemaker, Philadelphia, Pa.						
W. P. Barney	Seekonk	54.90	55.00	15.83	10.00	18.55
Second Grade (below 45 per cent Protein.)						
Andrews & Spellman Co., Providence, R. I.						
Anchor, ... W. J. Meek	Fall River	40.40	40.00	13.03	8.00	35.48
Greene Chicken Feed Co., Marblehead, Mass.						
Old Fashioned, ... Greene Chicken Feed Co.	Marblehead . . .	35.15	40.00	14.55	10.00	30.72
W. D. Higgins, South Framingham, Mass.						
J. F. Ray	Franklin	38.98	40.00	20.78	12.00	26.13
S. A. Meager & Co., Boston, Mass.						
F. H. Crane & Sons	Quincy Adams	43.69	40.00	16.02	15.00	29.94
Portland Rendering Co., Portland, Me.						
M. H. Rolfe	Newburyport . .	39.95	40.00	13.15	8.00	37.10
J. A. Torrey, Rockland, Mass.						
A. Culver Co	Rockland	41.42	40.00	23.95	15.00	22.47

MEAT AND BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Ash.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Beach Soap Co., Lawrence, Mass.							
Star, ... Bowen & Fuller	Leominster	21 75	30.00	11.52	10.00	56.22	—
Bowker Fertilizer Co., Boston, Mass.							
S. L. Davenport & Son .	N. Grafton	30.31	40.00	10.99	5.00	41.36	—
Joseph Breck & Sons, Boston, Mass.							
Knight Grain Co	Newburyport ..	23.19	33.00	17.42	10.00	42.46	—
Swifts Lowell Fertilizer Co., Boston, Mass.							
M. G. Williams	Raynham	45.84	35.00	8.49	8.00	35.95	—

BONE MEAL.

American AgriculturalChemicalCo.,Boston,Mass.							
Potter & Co	Athol	16 55	10.00	3.53	4.00	63.61	—
Greene Chicken Feed Co., Marblehead, Mass.							
Coarse Ground Bone, Greene Chicken Feed Co	Marblehead	24 26	—	1.95	—	54.55	—
A. L. Warren, Northboro, Mass.							
Blood Bros	Medfield	27 02	20.00	11 63	6 00	47.25	—

POULTRY MASH AND MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
Local Mixtures.							
Best of All Dry Mash. Bosworth & Son	Leominster ...	13 33	17 68	4.87	5 85	8 30	—
Morning Mash, ... N. E. Bryant & Co	Brockton	19.14	14 00	5.35	5.00	7 03	—
Perfect Dry Mash, .. J. B. Cover & Co	Lowell	14 54	15.00	5.53	3.00	8 03	—
Crescent Dry Ration, E. A. Cowee	Worcester	22 12	20.00	4.77	4 00	6 09	—
Creseent Poultry Feed E. A. Cowee	Worcester	14 94	15.00	4 12	4 00	6 05	—
Eureka Dry Mash, .. H. A. Crossman Co	Needham	20.23	20.00	4 72	5 00	6 93	5.00
Poultry Dry Mash ... R. W. Davies	Greenfield	18 74	18.00	3.67	5.00	9.04	—
Fish Mash, ... Greene Chicken Feed Co.	Marblehead	11 12	12.00	2 28	3.00	4 20	—
Growing Feed, ... Greene Chicken Feed Co.	Marblehead	11.78	12 00	3 24	3 00	4 46	—
Mash Feed, ... Greene Chicken Feed Co.	Marblehead	7 34	11.00	2 50	3.00	3 70	—
Poultry Mash ... S. B. Green & Co	Watertown	22 36	20.00	6 26	5 00	4.49	—
LexingtonPoultryMash Lexington Grain Co	Lexington	23 99	18.00	3.38	3 50	4.52	—
Mash Feed, ... Livingston Grain Co	Lowell	13 84	10 00	4 25	3.00	8 23	—
Poultry Hash, ... Ropes Bros	Danvers	15 76	18 00	4.87	4.00	8 65	—
Buffalo Cereal Co., Buffalo, N. Y.							
Griffin Bros	Fall River	20 14	—	5.31	—	3.62	—

POULTRY MASH AND MEAL.—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Chas. M. Cox Co., Boston, Mass.							
Wirthmore Growing Feed A. Culver Co.	Rockland	11.43	15.00	2.97	5.00	3.66	—
Wirthmore Growing Feed H. A. Crossman Co.	Needham	12.69	15.00	2.91	5.00	4.20	—
Wirthmore Growing Feed C. W. Bowker & Co.	Worcester	12.48	15.00	2.45	5.00	3.61	—
Wirthmore Poultry Mash C. W. Bowker & Co.	Worcester	12.34	12.00	3.78	3.00	7.77	—
E. A. Cowee, Worcester, Mass.							
Crescent Dry Ration I. J. Rowell	Pepperell	23.91	20.00	4.31	4.00	5.86	—
Growing Feed, I. J. Rowell	Pepperell	15.20	12.00	4.64	4.00	3.52	—
Albert Dickinson Co., Chicago, Ill.							
Queen Mash, J. F. Ray	Franklin	12.34	11.00	3.49	2.50	6.52	10.00
Queen Mash, F. A. Fales & Co.	Norwood	11.08	11.00	3.53	2.50	6.69	10.00
Green River Grain Co., Greenfield.							
A. D. Potter	Orange	15.46	16.46	3.80	4.14	8.00	—
Husted Milling Co., Buffalo, N. Y.							
Laying Mash, J. Lally	Milford	16.29	15.00	5.04	3.00	4.82	8.00
Mystic Milling & Feed Co., Rochester, N. Y.							
Puritan Laying Mash, H. B. Howland	Spencer	24.30	23.00	5.20	7.00	7.11	9.00
Park & Pollard Co., Boston, Mass.							
Dry Mash Feed, Conant & Co.	Littleton	22.42	23.00	2.22	3.00	6.05	—
Quaker Oats Co., Chicago, Ill.							
American, McKenzie & Winslow	Fall River	17.39	12.00	5.73	3.50	3.83	—
Purina Mills, St. Louis, Mo.							
Chicken Chowder, W. Parlett	Lee	19.09	16.00	4.29	2.50	7.43	11.50
Ross Bros. Co., Worcester, Mass.							
Every Morning Mash C. L. Beals & Co.	Winchendon	19.44	12.00	4.72	3.50	8.90	—
Shredded Wheat Co., Niagara Falls, N. Y.							
Shredded Wheat Waste W. G. Horton	Ipswich	10.99	—	2.72	—	2.11	—

CLOVER AND ALFALFA MEALS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Clarence S. Briggs, Fowler, Colorado.							
Alfalfa Meal, A. M. Haggart	Franklin	14.23	12.00	1.76	1.50	25.42	34.00
Alfalfa Meal, J. Lally	Milford	12.52	12.00	1.12	1.50	30.27	34.00
Albert Dickinson Co., Chicago, Ill.							
Alfalfa Meal, Dennison Plummer Co.	New Bedford	15.85	12.00	1.68	1.00	25.23	30.00
Thos. W. Emerson & Co., Boston, Mass.							
Cut Clover, G. F. Greene Coal Co.	Campello	9.63	12.00	1.63	2.00	24.13	—
Russell Grain Co., Kansas City, Mo.							
Square Deal Alfalfa Meal J. Burkhardt	Beverly	13.27	12.00	1.13	1.50	30.15	25.00
Square Deal Alfalfa Meal Milford Grain Co.	Milford	13.26	12.00	1.39	1.50	22.10	25.00

DISCUSSION OF THE INSPECTION.

I. Protein Feeds.

Cottonseed Meal. Pages 6-7

Fifteen samples each of choice and prime meals and one sample of cottonseed feed are reported. None of the samples collected were particularly inferior and there was no decided variation between analysis and guarantee. Several prime meals were misbranded as choice. The difference in average fiber content between choice and prime meals amounted to about 2 per cent which would indicate that prime meal may be simply a choice meal containing a larger percentage of hulls.

As a source of protein in the dairy ration, cottonseed meal continues to be comparatively economical. Pound for pound, it furnishes about 1 1-2 times as much digestible protein as gluten feed and about three times as much as wheat bran.

One sample of cottonseed feed collected contained about 24 per cent of protein and sold for $31 a ton. It has not much over 1-2 of the value of meal of good quality.

Average Analyses and Retail Prices.

	High Grades (Choice)	Medium Grades (Prime and Good).	High and Medium Grades.
	1909.	1909.	1909.
No. Samples,	32	21	53
Protein (per cent),	42.62	39.49	41.38
Fat (per cent),	8.60	8.23	8.46
Price a ton,	$34.12	$32.55	$33.48
	1910.	1910.	1910.
No. Samples,	23	25	48
Protein (per cent),	42.35	39.14	41.51
Fat (per cent),	7.96	8.07	8.02
Price a ton,	$37.43	$38.21	$37.32
	1911.	1911.	1911.
No. Samples,	15	15	30
Protein (per cent),	42.37	39.69	41.03
Fat (per cent),	8.38	8.07	8.23
Fiber (per cent),	6.86	8.54	7.70
Price a ton,	$34.36	$33.84	$34.06

Linseed Meal.
Page 8.

Two samples of New Process and eight samples of Old Process linseed meal were collected. The price asked was too high to render it an economical feeding stuff. The guarantee was practically maintained in every case.

Average Analyses and Retail Prices.

New Process.

	1908.	1909.	1910.	1911.
No. Samples,	6	5	5	2
Protein (per cent),	35.09	37.35	37.96	39.95
Fat (per cent),	3.28	3.37	2.50	2.70
Fiber (per cent),	—	—	—	7.20
Price a ton,	$33.50	$36.00	$37.80	$39.00

Old Process.

	1908.	1909.	1910.	1911.
No. Samples,	9	11	17	8
Protein (per cent),	34.94	35.89	35.96	37.11
Fat (per cent),	6.73	6.22	6.10	5.76
Fiber (per cent),	—	—	—	7.15
Price a ton,	$35.44	$36.81	$40.65	$40.50

Gluten Feed.
Page 8.

But one sample of gluten feed, the Bay State, ran below its guarantee. This was not due to adulteration but rather to the fact that more starch was left in this product than in other brands. Gluten feed is a corn by-product resulting from the manufacture of corn starch. It contains the corn gluten, some of the corn germ and all of the hull or bran together with more or less corn starch and other similar bodies. In the past, in order to satisfy a popular prejudice, it has been colored yellow, a practice which is now happily falling into disuse.

Gluten feed can be considered a satisfactory and economical feed when used as a component of rations for dairy stock.

Average Analyses and Retail Prices.

	1909. First Grade.	1909. Second Grade.	1910. First Grade.	1910. Second Grade.	1911. All Samples.
No. Samples,	50	5	33	6	11
Protein (per cent),	26.52	21.83	25.22	20.91	25.77
Fat (per cent),	2.81	4.63	3.17	6.00	3.35
Fiber (per cent),	—	—	5.92	7.53	6.42
Price a ton,	$32.68	$32.00	$31.88	$33.33	$28.88

Distillers' Dried Grains.
Page 9.

Seven samples of corn distillers' grains and five samples of rye grains were collected. The corn grains contain about 30 per cent of protein while the rye grains contain from 12 to 18 per cent.

The corn grains have been on the market in New England for a number of years, while the rye grains have not, until the past season, been extensively offered, having previously been exported. During the past season rye grains have been freely offered at $16 per ton in bags, wholesale, f. o. b. Boston points, which would be substantially $1 per hundred at retail. Such a price renders this article decidedly economical for northern feeders.*

Average Analyses and Retail Prices.

Corn Grains.

	1908.	1909.	1910.	1911.
No. Samples,	17	18	14	7
Protein (per cent),	30.21	30.54	29.67	30.17
Fat (per cent),	8.25	11.69	11.16	11.84
Fiber (per cent),	—	—	12.24	11.16
Price a ton,	$32.89	$34.00	$33.73	$32.66

Rye Grains.

	1911.
No. Samples,	5
Protein (per cent),	16.44
Fat (per cent),	6.35
Fiber (per cent),	13.62
Price a ton,	$22.33

*For further information in regard to distillers' grains, see Part II. of the Twenty-third Annual Report of the Massachusetts Agricultural Experiment Station, page 72.

Malt Sprouts and Brewers' Dried Grains. Page 9.

But one sample of brewers' dried grains and five samples of malt sprouts were collected. Malt sprouts and brewers' dried grains are extensively used as components of molasses and other proprietary feeds. In New England, brewers' grains are sold direct to nearby consumers undried. In the Middle West, the large brewers maintain drying plants where the product can be dried and then shipped to a distance, much of the product being exported. The brewers' grains and malt sprouts collected practically met their guarantees and were of good quality.*

Average Analyses and Retail Prices.

Malt Sprouts.

	1908.	1909.	1910.	1911.
No. Samples,	9	13	8	5
Protein (per cent),	27.61	26.88	26.72	26.14
Fat (per cent),	0.89	1.08	1.01	1.01
Fiber (per cent),	—	—	12.58	12.98
Price a ton,	$26.75	$27.67	$27.81	$26.50

Brewers' Grains.

	1909.	1910.	1911.
No. Samples,	5	2	1
Protein (per cent),	26.86	30.35	25.54
Fat (per cent),	7.09	6.81	6.77
Fiber (per cent),	—	12.95	15.35
Price a ton,	$29.75	$30.00	$27.00

Wheat By-Products.

Owing to a lack of funds the analysis of wheat by-products was not made. These products were given a cursory examination to determine if adulteration was being attempted. Beyond the fact that some samples contained rather more added screenings than should be found in a first-class wheat feed, no adulteration was found.

*For further information relative to these products, see the article "Distillery and Brewery By-products," Twenty-third Annual Report of the Massachusetts Agricultural Experiment Station.

Average Analyses and Retail Prices.

Wheat Middlings, Flour.

	1908.	1909.	1910.	1911.
No. Samples,	28	20	18	7
Protein (per cent),	17.16	16.98	18.82	—
Fat (per cent),	4.69	4.87	5.12	—
Price a ton,	$32.80	$33.56	$33.45	$32.57

Wheat Middlings, Standard.

	1908.	1909.	1910.	1911.
No. Samples,	47	43	52	30
Protein (per cent),	17.14	17.53	17.56	—
Fat (per cent),	5.09	5.29	5.20	—
Price a ton,	$31.02	$30.04	$30.94	$30.17

Wheat Mixed Feed.

	1908.	1909.	1910.	1911.
No. Samples,	133	124	163	76
Protein (per cent),	16.19	16.49	16.97	—
Fat (per cent),	4.65	4.74	4.71	—
Price a ton,	$31.12	$30.17	$29.93	$29.51

Wheat Bran.

	1908.	1909.	1910.	1911.
No. Samples,	52	38	63	23
Protein (per cent),	15.47	15.92	16.50	—
Fat (per cent),	4.53	4.57	4.86	—
Price a ton,	$29.40	$28.65	$28.68	$28.30

Dairy Feeds.
Page 10.

Mixed proprietary feeding stuffs consisting of several by-products and containing 15 or more per cent protein are classified in this bulletin as dairy feeds. They are usually advertised as complete grain rations for dairy stock; a statement which is not always borne out by feeding practice. Experience has shown that in order to feed a balanced ration when the necessary amount of home-grown roughage is at hand, the grain ration should have the following qualifications:

1. It should be bulky, palatable and free from mould and rancidity.
2. It should contain from 20 to 25 per cent of protein.

3. It should not contain over 9 per cent of fiber.

Seven pounds of such a mixture is a fair average amount for cows weighing 800 to 900 lbs., which are yielding 10 qts. of milk daily. For every two quarts of milk yielded in excess of this amount, the grain ration may be increased by one pound.

The dairy feeds collected varied widely in composition, as will be seen by referring to the tables of analyses. Union grains, Unicorn and Wirthmore brands are generally found to be the most satisfactory of this class of feed stuffs.

Bibby's Oil Cake Feed, an imported product, is comparatively expensive. It is doubtful if it has a much greater nutritive value than standard wheat middlings.*

Buffalo Creamery Feed carried a fair percentage of protein, and rather more fiber—derived from oat hulls—than is economical.

Algrane Milk Feed did not contain enough protein to be considered a complete grain ration.

Sugarota Milk Meal contained a large amount of malt sprouts, which would tend to render the mixture rather unpalatable.

The Blue Ribbon Dairy Feed exceeded its maximun guarantee in fiber. It was the only feed in this group that contained molasses, but on account of its high protein content was not placed with the molasses feeds.

Molasses Feeds. **Pages 10-11.**

Molasses feeds usually consist of cereal grains or their by-products, grain screenings, one or more high grade concentrates and molasses. Owing to the fact that feeds of this character contain low grade by-products which would have little or no sale when unmixed with other material, manufacturers usually offer these goods at a price considerably below that ruling for standard feeding stuffs. Retailers frequently adopt the short-sighted policy of selling molasses feeds at such a price as to leave a wide margin of profit. When sold on their merits at a fair profit, they form a legitimate outlet for low grade material. Molasses feeds have improved considerably in composition and in consequent feeding value within the last few years. Many of them have their true composition attached in order to comply with the laws of other states, and the purchaser by noting the tag can usually inform

*See 18th Annual Report of the Hatch Experiment Station, pp. 79-85.

himself as to the materials of which they are composed as well as their chemical composition.

Calf Meals.
Page 11.

Five samples of calf meal are reported. They are intended as a whole or partial milk substitute for young calves. All of these meals will undoubtedly serve as a partial milk substitute for calves intended for dairy purposes; it is not best to begin to feed them until about three weeks after birth. A satisfactory calf meal should be finely ground and composed of clean material free from taint or any noticeable amount of fiber.

Miscellaneous Feeds.
Page 11.

Pig Meal, manufactured by J. Bibby & Sons of Liverpool, England, practically met its guarantee. It is a proprietary mixture consisting of several concentrates. The retail price as given by the agent was $2.75 a hundred. It is believed that fully as satisfactory a ration could be made of domestic products, and at a more economical figure.

Maizo Oil Meal appeared to be a corn product quite similar in appearance to hominy feed, but containing rather more of the corn germ. It is a desirable article.

Oil Cake Feed for Horses is an imported product sold at a price in excess of its comparative feeding value.

Ropes' Horse Feed, put up and sold only by the manufacturer, was composed of satisfactory by-products and at the price asked could not be considered expensive.

II. Starchy (Carbohydrate) Feeds.

Corn Meal.
Page 12.

Nineteen samples of corn meal were collected. Many of these did not consist of the entire ground grain, but were more in the nature of by-products derived from the manufacture of table meals and cracked corn. From other samples a considerable portion of the bran and germ had been removed. While such meals are more attractive in appearance, they cannot be considered of any greater feeding value than meals made from the entire grain.

The high moisture content of the meals collected is worthy of note; the average for the nineteen samples being over 20 per cent. This can be explained by the fact that at the time the samples were

drawn (Jan.—Feb.) new corn was just coming into the market. The water content of meals made from old corn and collected during the present autumn will be determined with a view to ascertaining the difference in water content due to the drying out of the corn as the season advances. If dealers carry corn during the winter months which contains an excessive amount of water, it is not surprising that a great deal of trouble is experienced through heated meal as the weather grows warmer.

Average Analyses and Retail Prices.

	1909.	1910.	1911.
No. Samples,	41	51	19
Protein (per cent),	8.85	8.55	8.17
Fat (per cent),	3.59	3.81	2.77
Fiber (per cent),	1.88	1.84	1.58
Price a ton,	$30.79	$29.28	$24.10

Ground Oats. Rye Meal. **Pages 12-13.** Several samples of ground oats and rye meal were collected, examined and found to be free from adulteration.

Hominy Meal. **Pages 13-14** Hominy meal, feed, or chop is a pure corn by-product usually made from white corn, although yellow hominy is occasionally found. It has substantially the same feeding value, and can be substituted for corn meal whenever the latter can be used to advantage. It contains slightly more protein and more fiber and fat than clear corn and correspondingly less starchy matter. Hominy meal, when fed with oats, constitutes a very satisfactory ration for horses.

The twenty-three samples collected were of good quality and practically met their guarantees.

Star Feed cannot be properly classed with hominy feed as it is an admixture of hominy feed and ground corn cob. This fact is, however, clearly stated on the attached tag and no one need be misled as to its true composition. Its feeding value is less than that of the straight feed.

Average Analyses and Retail Prices.

	1908.	1909.	1910.	1911.
No. Samples,	47	51	62	21
Protein (per cent),	10.20	11.21	10.29	10.55
Fat (per cent),	7.79	8.61	7.94	7.79
Fiber (per cent),	—	—	4.21	3.87
Price a ton,	$31.88	$31.72	$30.13	$26.62

Provender.
Page 14.

Provender is a local name for mixtures of pure corn and oats ground together in varying proportions. All samples collected proved to be free from adulteration, but in many instances the moisture content proved rather high, due, no doubt, to the quality of the corn used.

Corn and Oat Feeds.
Pages 15-17.

Under this heading are grouped proprietary mixtures usually consisting of some inferior by-product such as oat feed together with corn and possibly small amounts of high grade protein concentrates in order to make them more saleable. They are extensively advertised and sold under attractive trade names. They can in no way be considered as balanced grain rations for dairy cows, but if clean and sweet give fair satisfaction as an oat substitute for horses.

If used at all for milch cows, it should be as a component part of a grain ration containing cottonseed meal, gluten feed or other high protein feed stuff. Many samples contained an excessive amount of fiber which tends to materially lower their digestibility and consequent feeding value.

Adulterated Wheat Feeds.
Page 17.

The feeding stuffs found in this group are simply wheat by-products containing a considerable proportion of ground corn cobs. The average price for wheat mixed feeds at the time of the collection was made was $29.51 per ton; that of the adulterated wheat feeds was $26.43 per ton. Figuring on the digestible matter contained in these two classes of feed, if straight wheat feed is worth $29.50 per ton, the adulterated product would be worth about $25 a ton. Do not buy the adulterated article!

Dried Beet Pulp. Page 17.

Dried beet pulp, the dried residue from beet sugar factories, may or may not contain the residual molasses. The greater part of that found in the Massachusetts markets does not contain molasses. The amount offered for sale appears to be on the increase. Beet pulp should be moistened before feeding and can be considered a satisfactory though not economical substitute for silage, roots or other succulent home-grown feeds.*

Miscellaneous Starchy Feeds. Page 18.

Dried Grains, put out by A. H. Brown & Bros. are said to be the dried cereal residue resulting from the manufacture of Mellen's Food.

Oat Feed, of which but one sample is reported, cannot be said to have a feeding value equal to good English hay.

Molassine Meal consisted of molasses and an unidentified absorbent. It contained about 22 per cent of water.

Buckwheat Feed. The sample collected contained 12.87 per cent protein and nearly 30 per cent fiber. The high fiber content indicates a large excess of hulls and makes it an undesirable feeding stuff. Buckwheat middlings with about 25 per cent protein and some 10 per cent fiber is a decidedly more desirable article.

Germaline is simply a mixture of corn meal and molasses. The sample collected contained about 19 per cent water.

Molasses Horse Feed according to its guarantee contained corn, oats, oat clippings, middlings, molasses and salt. At the price asked, $26 a ton, it could not be considered expensive.

Flax Shives. The sample reported had about the same composition as overripe English hay. It consisted of ground flax stalks and pods and is quite indigestible and unsatisfactory for feeding purposes.

III. Poultry Feeds.

Animal By-Products. Pages 18-19.

Meat Scraps. A good grade of scraps should be free from taint, should be ground moderately coarse, and should not contain an excess of ash or fat. Meat scraps are sometimes made from diseased animals. While disease germs

*See special article on "Dried Beet Residue," by Dr. Lindsey in Part II of 22d Annual Report of this station, pp. 21-26.

harbored in meat of this character are probably killed by thorough cooking, it is felt that meat scraps should be so tagged as to indicate their source.

As reported, they are divided into two groups; (*a*) those containing over 45 per cent and (*b*) less than 45 per cent protein. The difference in protein content is due largely to the amount of bone present. As scraps are purchased and fed largely on account of their meat or protein content, other things being equal, the preference should be given to those brands containing the highest percentage of protein.

Meat and Bone Meal. But four samples are reported. Those of the Beach Soap Co. and Bowker Fertilizer Co. fell noticeably below their guarantees. This is not usually the case, and it would be an injustice to these firms to state that these samples represented the average output.

Poultry Mashes and Meals. Pages 19-20.

The manufacture and sale of prepared poultry mashes appears to be growing rapidly. Most of those offered do not contain ingredients that cost over $1.60 per hundred, they usually sell for $1.80 to $2. It is economy for the poultry man to study the needs of his fowls and to purchase and mix the ingredients himself.

Chick and Scratching Grains.

The chick and scratching grains collected were not analyzed, as these feeds consisting as they do largely of whole or cracked grains, can be readily examined by the purchaser and the presence of an excessive amount of weed seeds, grit or other undesirable material easily detected. Most of these mixtures will probably prove satisfactory although home mixtures will prove somewhat cheaper. Where poultry is kept on the farm, home-grown grain, especially corn, should be utilized. A mixture consisting of one-half cracked corn, one-fourth wheat and one-fourth barley or oats will make a satisfactory ration.

Alfalfa and Clover Meals. Page 20.

The alfalfa meal collected showed a wide variation in fiber content. Finely cut rowen, home-grown clover cut in the bud and moistened with hot water, roots or cabbage will furnish vegetable matter more economically. When it is necessary to purchase, preference should be given to those brands which contain the smallest amount of fiber.

MARKET PRICES OF COMMERCIAL FEED STUFFS FOR 1911. (January to August Inclusive).

FEED STUFFS.	Monthly Wholesale Ton Prices—1911.								Average.
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	
Cottonseed Meal	$30.19	$29.25	$28.55	$29.31	$29.55	$30.13	$30.88	$30.88	$29.84
Linseed Meal (N. P. & O. P.)	36.25	36.44	36.10	34.75	34.50	34.50	34.50	—	35.29
Gluten Feed (sacked)	26.19	26.25	25.00	24.90	24.84	25.70	25.85	29.10	25.98
Gluten Feed (bulk)	—	—	—	—	23.90	24.47	24.90	27.98	25.31
Distillers' Dried Grains	30.25	30.50	29.00	28.25	27.75	27.75	29.57	30.75	29.23
Malt Sprouts (sacked)	22.88	21.75	19.90	14.48	19.16	19.55	19.50	—	19.60
Flour Middlings (Red Dog)	29.19	28.81	28.67	29.94	28.50	28.69	30.13	32.63	29.57
Standard Middlings (shorts)	27.28	26.83	26.73	27.32	27.43	26.72	27.82	30.54	27.58
Mixed Feed	27.76	27.67	27.58	28.25	27.98	26.94	27.22	28.19	27.69
Bran, Spring	26.06	25.88	26.05	27.44	26.50	24.19	24.63	25.44	25.77
Bran, Winter	26.38	26.13	26.30	27.69	26.70	24.25	24.75	26.06	26.03
Hominy Meal (sacked)	23.53	23.24	22.63	22.55	25.61	25.71	27.31	28.16	24.84
Hominy Meal (bulk)	22.45	21.97	21.59	22.06	24.62	24.71	26.31	26.97	23.84
Corn Meal	21.40	21.10	21.10	22.50	24.30	25.10	27.30	28.20	23.88
Corn, No. 2 yellow	20.36	20.00	20.18	21.79	23.21	23.71	26.03	26.66	22.77
Oats, No. 2 clipped white	25.00	24.13	23.75	24.63	26.13	29.13	32.50	30.63	26.99
Rye, No. 1	30.89	31.07	31.46	33.80	35.48	36.14	35.68	35.89	33.80
Feed Barley	21.96	23.85	25.63	28.96	29.17	29.17	30.75	31.25	27.59

BULLETIN No. 140. DECEMBER 1911.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

INSPECTION OF COMMERCIAL FERTILIZERS

BY

H. D. HASKINS, L. S. WALKER, J. F. MERRILL and R. W. RUPRECHT.

This bulletin gives a detailed report of the fertilizer inspection for 1911. It gives the full text of the new fertilizer law recently enacted, states the number of fertilizers inspected, gives trade values of fertilizer ingredients, provides a summary showing average composition of unmixed fertilizing material as well as pound cost of each element of plant food furnished. Special attention is called to commercial shortages existing in both unmixed fertilizing materials and mixed goods. Particular emphasis is laid upon the economy of purchasing only high grade fertilizers. A summary table shows the general standing of each manufacturer's brands. A discussion is made of the quality of plant food found present in the mixed goods, particularly with reference to the activity of the organic nitrogen. Tables of analyses give the detailed composition of all fertilizers sold in the state.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, *Chemist.*

INSPECTION OF COMMERCIAL FERTILIZERS

FOR THE SEASON OF 1911.

By H. D. Haskins, *Chemist in Charge.*

Assisted by

L. S. Walker, J. F. Merrill* and R. W. Ruprecht.†

The fertilizer inspection work for the year has been carried on under the old fertilizer law as amended in 1907 (Chapter 289.) December 1, 1911, a new fertilizer law went into effect, the full text of which is herewith given.

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS. (Chapter 388, 1911.)

Be it enacted, etc., as follows:

Statements to be printed on label accompanying the fertilizer.

Section 1. No commercial fertilizer shall be sold or offered or exposed for sale in this commonwealth without a plainly printed label accompanying it, displayed in the manner hereinafter set forth, and truly stating the following particulars:—

1. The number of pounds of the fertilizer sold or offered or exposed for sale.

2. The name, brand or trademark under which the fertilizer is sold, and, in the case of agricultural lime, its particular form.

3. The name and principal address of the manufacturer, importer or other person putting the fertilizer on the market in this commonwealth.

4. The minimum percentage of each of the following constituents which the fertilizer may contain: (a) nitrogen, (b) phosphoric acid soluble in distilled water, (c) available phosphoric acid, (d) total phosphoric acid, (e) potash soluble in distilled water; except that in the case of undissolved bone, untreated phosphate rock, tankage, pulverized natural manures, the ground seeds of plants, and wood ashes, when sold unmixed with other substances, the minimum percentage of total phosphoric acid therein may be stated in place of the percentages of soluble and available phosphoric acid; and except that in the case of agricultural lime the label shall truly

*Resigned December 1, 1911.

†Mr. James C. Reed assisted in the work for three months, beginning September 1st.

Note: The writer wishes to acknowledge valuable suggestions and criticisms offered by Dr. J. B. Lindsey relative to the subject matter of this bulletin.

state the following: (a) minimum and maximum percentage of total lime, (b) minimum and maximum percentage of total magnesia, (c) minimum percentage of lime and magnesia combined as carbonates, (d) minimum percentage of lime sulphate in gypsum or land plaster.

5. If any part of the nitrogen contained in the fertilizer is derived from pulverized leather, raw, roasted or steamed; or from untreated hair, wool waste, peat, garbage tankage, or from any inert material whatsoever, the label shall truly state the specific material or materials from which such part of the nitrogen is derived.

Concerning attachment of label.

SECTION 2. When any fertilizer is sold or offered or exposed for sale in packages, the label shall be affixed in a conspicuous place on the outside thereof. When any fertilizer, other than the product of gas-houses, known as gas-house lime, is offered or exposed for sale in bulk the label shall be affixed in a conspicuous place to the bin or other enclosure in which the fertilizer is contained but need not state the number of pounds thereof. And when any fertilizer other than gas-house lime aforesaid is sold in bulk the label shall be affixed in a conspicuous place to the car or other vehicle in which the fertilizer is shipped or delivered and shall state the number of pounds thereof. When any fertilizer is sold in packages furnished by the purchaser the seller shall furnish the labels therefor.

Definition of guaranteed analysis; Wagner method to be used for phosphatic slag.

SECTION 3. The provisions of the printed label required by this act relating to the constituents contained in any fertilizer shall be known and recognized as the guaranteed analysis of such fertilizer, and the available phosphoric acid in basic phosphatic slag shall be stated in the label thereof on the basis of the results of an analysis by the Wagner Method, so-called, until such time as the Association of Official Agricultural Chemists of North America shall adopt a method of analysis for basic phosphatic slag, after which the available phosphoric acid shall be stated on the basis of an analysis by the method of said association.

Definition of violation of previous sections.

SECTION 4. Any manufacturer, importer, or other person selling or offering or exposing for sale in this commonwealth a commercial fertilizer or brand of commercial fertilizer, any constituent part of which is of a smaller percentage than it is stated to be in the label of said fertilizer, and any manufacturer, importer, or other person selling or offering or exposing for sale in this commonwealth a fertilizer or brand of fer-

[illegible] shall be deemed to have committed a violation of this act.

Certified copy of label to be filed. Cost of analysis fee and time of payment.

SECTION 3. No manufacturer, importer or other person shall sell or offer or expose for sale in this commonwealth any commercial fertilizer until he shall have filed with the director of the Massachusetts Agricultural Experiment Station a copy certified by him to be a true copy of the label required by this act, specifying therein as to number of pounds, for every brand of fertilizer to be sold or offered or exposed for sale in this commonwealth, and shall have paid to the said director an annual analysis fee for every brand aforesaid as follows: eight dollars for nitrogen, eight dollars for phosphoric acid, and eight dollars for potash contained or stated to be contained in any such brand of fertilizer, and twelve dollars for every brand of agricultural lime except gas-house lime. The certified copy of the label of every brand of fertilizer to be sold or offered or exposed for sale in this commonwealth shall be filed with, and the proper analysis fee for every such brand shall be paid to, the director of the Massachusetts Agricultural Experiment Station prior to the first day of January of the calendar year in which the brand is to be sold or offered or exposed for sale: provided, however, that whenever any manufacturer, importer or other person desires at any time to sell or to offer or expose for sale in this commonwealth any brand of commercial fertilizer in respect of which the requirements of this section as to the filing of a copy of the label thereof and the payment of the analysis fee therefor have not been complied with before the first day of January of said year, the said manufacturer, importer or other person may offer or expose for sale and sell the said brand in this commonwealth upon filing a certified copy as aforesaid of the label thereof and paying the full analysis fee therefor. No agent or other person shall be obliged to file a copy of the label of, or pay an analysis fee for, any brand of fertilizer for which a certified copy of the label has been filed and the analysis fee has been paid by the manufacturer or importer of such brand.

Any manufacturer, importer or other person filing with the director of the Massachusetts Agricultural Experiment Station a false copy of the printed label of any fertilizer or brand of fertilizer shall be deemed to have committed a violation of this act.

Director to issue certificate of compliance when conditions are fulfilled.

SECTION 4. When both the certified copy of the label of any brand of fertilizer has been filed and the analysis fee therefor has been paid as provided in section three of this act, the director of the Massachusetts Agricultural Experiment Station shall issue to those

to be issued a certificate to that effect; and the certificate shall be deemed to authorize the sale in this commonwealth, in compliance with this act, of the brand of fertilizer for which the certificate is issued up to and including the thirty-first day of December of the year for which it is issued.

Collection and analysis of samples and publication of results.

SECTION 7. Every commercial fertilizer and brand of commercial fertilizer sold or offered or exposed for sale in this commonwealth shall be subject to analysis by the director of the Massachusetts Agricultural Experiment Station or by his duly designated deputy or deputies. And the said director is hereby authorized and it is made his duty to make or cause to be made in each year one or more analyses of every fertilizer and brand of fertilizer sold or offered or exposed for sale in this commonwealth, and to collect the annual analysis fee provided for by section five of this act. The said director, his inspectors and deputies, are further authorized to enter upon any premises where any commercial fertilizer is sold or offered or exposed for sale to ascertain if the provisions of this act are complied with, and to take samples for analysis as provided for by this act. The analysis of all fertilizers shall be made by the methods adopted by the Association of Official Agricultural Chemists of North America, except that basic phosphatic slag may be analyzed by the Wagner Method, so-called, until a method of analysis therefor is adopted by said association. The said director shall have the right to publish or cause to be published in reports, bulletins, special circulars or otherwise, the results obtained by said analyses, and in connection therewith shall, in each case, state the cost of equivalent amounts of nitrogen, phosphoric acid and potash in unmixed materials when bought for cash on the market at retail. Said reports, bulletins, circulars, or other publications shall also contain such additional information in relation to the character, composition, value and use of the fertilizers analyzed as the said director in his discretion may see fit to include. The said director may at any time make or cause to be made for any person a free analysis of any commercial fertilizer or brand of commercial fertilizer sold or offered or exposed for sale in this commonwealth, but he shall not be obliged to make such free analysis or to cause the same to be made, unless the samples therefor are taken and submitted in accordance with the rules and regulations which may be prescribed by him. The results of any analysis made in accordance with the provisions of this act, except a free analysis as aforesaid, shall be sent by the director to the person named in the printed label of the fertilizer analyzed at least fifteen days before any publication thereof.

Sampling of fertilizers.

SECTION 8. All samples of commercial fertilizers taken for analysis shall be of not less than substantially one and one-half pounds in weight, and every sample shall be taken, whenever the circumstances conveniently permit, in the presence of the person selling or offering or exposing for sale the fertilizer sampled, or of a representative of such person. Broken packages shall not be sampled, and all samples shall be taken from substantially ten per cent of the fertilizer to be sampled, except that in the case of a fertilizer sold or offered or exposed for sale in bulk ten single samples shall be taken from as many different portions of the lot. All samples taken shall be thoroughly mixed and divided into two nearly equal samples, placed in suitable vessels, and marked and sealed. Both shall be retained by the director, but one shall be held intact by him for the period of one year at the disposal of the person named in the label of the fertilizer sampled.

Penalty for obstructing director or deputy. Prosecutions at discretion of director.

SECTION 9. Any person hindering or obstructing the director of the Massachusetts Agricultural Experiment Station, or any inspector or deputy of the said director, in the discharge of the authority or duty conferred or imposed by any provision of this act and any person violating any provision of sections one, two, three, four and five of this act shall be fined not less than fifty dollars and not more than two hundred dollars for each offence. It shall be the duty of the said director to see that the provisions of this act are complied with, and he may, in his discretion, prosecute or cause to be prosecuted any person violating any provision of this act. But no complaint based upon an analysis of samples shall be made for any such violation, if the samples were taken otherwise than as provided in this act. And no complaint shall be made for failure of any fertilizer or brand of fertilizer to meet the guaranteed analysis thereof if the analysis of such fertilizer made by the director, or by his deputy or deputies. shows the amounts of the constituents thereof to be substantially equivalent to the percentages stated in the label of the fertilizer.

Analysis fees turned over to treasurer. Accounts to be audited.

SECTION 10. All fees collected by the director of the Massachusetts Agricultural Experiment Station under the provisions of this act shall be turned over by him to the treasurer of the said station, and the amounts received and disbursed shall be kept in a separate account, and shall be audited and reported, as are other moneys placed in charge of the trustees of

the Massachusetts Agricultural College. The money collected under the provisions hereof shall be used under the authority of the said director to meet the expenses incurred in carrying out the provisions of the act, and should there be a surplus, the surplus shall be used in the Massachusetts Agricultural Experiment Station, under the authority of its director, for experiments and research relative to soils, fertilizers and manures.

Definition of terms. SECTION 11. In this act unless the context or subject-matter otherwise requires,

"Agricultural lime" includes all the various forms of lime intended or sold for fertilizing purposes.

"Available phosphoric acid" means the sum of the soluble and reverted phosphoric acid, except that, as applied to basic phosphatic slag, the term "available phosphoric acid" shall mean that part of the phosphoric acid made soluble by the Wagner Method, so-called, until such time as the Association of Official Agricultural Chemists of North America shall adopt a method for basic phosphatic slag, after which it shall mean that part of the phosphoric acid made soluble by the method of said association.

"Brand" means any commercial fertilizer distinctive by reason of name, trademark or guaranteed analysis or by any method of marking.

"Commercial fertilizer" includes every natural or artificial manure containing nitrogen or phosphoric acid or potash or lime, except the excrements and litter from domestic animals when sold in their natural state; but dried or partly dried manure, pulverized or ground, shall be included as a commercial fertilizer.

"Copy" means certified copy.

"Fertilizer" means commercial fertilizer.

"Importer" means a person who procures for sale in this commonwealth commercial fertilizers made in other states or countries.

"Label" means printed label.

"Lime" means calcium oxide (CaO).

"Magnesia" means magnesium oxide (MgO).

"Packages" includes sacks and bags and all other receptacles.

"Person" includes a corporation or partnership or two or more persons having a joint or common interest.

"Phosphoric acid" means phosphoric anhydrid (P_2O_5.)

"Potash" means potassium oxide (K_2O).

SECTION 12. Sections eleven to seventeen inclusive of chapter fifty-seven of the Revised Laws and chapter two hundred and eighty-nine of the acts of the year nineteen hundred and seven are hereby repealed.

SECTION 13. This act shall take effect on the first day of December in the year nineteen hundred and eleven. (*Approved May 4, 1911.*)

Remarks on the Law.

A comparison of the new law with the one which is superseded shows a number of essential differences, among the most important of which may be mentioned:

1. The provisions for the inspection and analysis of the various brands of agricultural lime.

2. The requiring of a statement of available phosphoric acid in basic slag phosphate, based upon an analysis made by the Wagner Method.

3. The payment of an analysis fee of $8.00 for each ingredient, nitrogen, potash and phosphoric acid, in place of $5.00 as required in the old law; also an analysis fee of $12.00 for each brand of agricultural lime. The increase in income due to the payment of a larger analysis fee will enable the Station to make a more extensive and complete collection of fertilizer samples and likewise provide for a study of the availability of the organic nitrogen.

4. The filing of a certified copy of the label and the payment of the inspection fee on all fertilizer materials on or before January 1st, instead of May 1st as formerly.

5. The taking of duplicate samples one of which is to be held intact by the Station for one year at the disposal of the manufacturer or the person responsible for placing the article upon the market. It was believed that the samples thus cared for would be more easily available if wanted than when left with the agent who, in many cases is likely to be careless in this respect.

Manufacturers and Brands.

During the year, 88 manufacturers, importers and dealers, including the various branches of the trusts, have secured certificates for the sale of 492 different brands of fertilizer, agricultural chemicals and raw products in the Massachusetts markets. Inspection fees have been paid on twenty-seven more brands than during the previous year.

These brands may be classed as follows:

Complete fertilizers	332
Fertilizers furnishing phosphoric acid and potash	10
Ground bone, tankage and dry ground fish	53
Chemicals and organic nitrogen compounds	97
	492

Following will be found a list of those who have recorded their goods for sale in Massachusetts for the season of 1911, together with the name of each brand:

W. H. Abbott, Holyoke, Mass.

Abbott's Animal Fertilizer,
Abbott's Tobacco Fertilizer,
Abbott's Onion Fertilizer,
Abbott's Eagle Brand.

The American Agricultural Chemical Co., 92 State St., Boston, Mass.

Bradley's Niagara Phosphate,
Bradley's Eclipse Phosphate for All Crops,
Bradley's Columbia Fish and Potash,
Bradley's Corn Phosphate,
Bradley's Potato Fertilizer,
Bradley's Seeding Down Manure,
Bradley's XL Superphosphate of Lime,
Bradley's Potato Manure,
Bradley's Complete Manure for Corn and Grain,
Bradley's Complete Manure for Top Dressing Grass and Grain,
Bradley's English Lawn Fertilizer,
Bradley's Complete Manure for Potatoes and Vegetables,
Bradley's Complete Manure with 10% Potash,
Bradley's High Grade Fertilizer with 10% Potash,
Clark's Cove Bay State Fertilizer,
Clark's Cove Bay State Fertilizer, G. G.
Clark's Cove Potato Manure,
Clark's Cove Great Planet Manure,
Clark's Cove Potato Fertilizer,
East India A. A. Ammoniated Superphosphate,
Cumberland Superphosphate,
Cumberland Potato Fertilizer,
Crocker's Potato, Hop and Tobacco Phosphate,
Church's Fish and Potash "D",
Northwestern Empire Special Manure,
Darling's General Fertilizer,
Darling's Farm Favorite,
Darling's Potato Manure,
Darling's Potato and Root Crop Manure,
Darling's Complete 10% Manure,
Darling's Blood Bone and Potash,
Farquhar's Vegetable and Potato Fertilizer,
Farquhar's Lawn and Garden Dressing,
Farquhar's Pure Ground Bone,
Great Eastern Garden Special,
Great Eastern Northern Corn Special,
Great Eastern Vegetable, Vine and Tobacco,
Great Eastern General,
Pacific Potato Special,
Pacific High Grade General,
Soluble Pacific Guano,
Packer's Union Gardeners' Complete Manure,
Packer's Union Animal Corn Fertilizer,
Packer's Union Potato Manure,
Quinnipiac Corn Manure,
Quinnipiac Potato Phosphate,
Quinnipiac Potato Manure,
Quinnipiac Market Garden Manure,
Quinnipiac Phosphate,
Read's Standard Superphosphate,
Read's Practical Potato Special,
Read's Farmers' Friend Superphosphate,
Read's Vegetable and Vine Fertilizer,
Read's High Grade Farmers' Friend Superphosphate,
Standard Guano for all Crops,
Standard Fertilizer,
Standard Special for Potatoes,
Standard Complete Manure,
Wheeler's Corn Fertilizer,
Wheeler's Potato Manure,
Wheeler's Havana Tobacco Grower,
A. A. C. Co.'s Grass and Oats Fertilizer,
Williams & Clark's Americus Potato Manure,
Williams & Clark's Americus Ammoniated Bone Superphosphate,
Williams & Clark's Potato Phosphate,
Williams & Clark's Americus High Grade Special for Potatoes and Vegetables,
Williams & Clark's Prolific Crop Producer,
Williams & Clark's Royal Bone Phosphate for all Crops,
Williams & Clark's Americus Corn Phosphate,
Genuine German Kainit,
Dissolved Bone Black,
Plain Superphosphate,
Thomas Phosphate Powder (Basic Slag),
Tankage,
Muriate of Potash,
High Grade Sulfate of Potash,
Nitrate of Soda,
Sulfate of Ammonia,
Double Manure Salt,
Ground Untreated Phosphate Rock,
Fine Ground Bone,
Dry Ground Fish,
High Grade Fertilizer with 10% Potash,

Grass & Lawn Top Dressing,
Tobacco Starter and Grower,
Special Grass and Garden Mixture,

American Cotton Oil Co., 27 Beaver St., New York City.

Choice Cottonseed Meal,
Prime Cottonseed Meal.

Armour Fertilizer Works, 930 Equitable Bldg., Baltimore, Md.

Grain Grower,
All Soluble,
Market Garden,
Complete Potato,
Fish and Potash,
Ammoniated Bone with Potash,
High Grade Potato,
Bone, Blood and Potash,
Fruit and Root Crop Special,
Onion Special,
Special Value,
Bone Meal,
Nitrate of Soda,
Muriate of Potash,
R. T. Prentiss' Top Dressing,
R. T. Prentiss' Potato and Vegetable,
R. T. Prentiss' Corn Fertilizer,

Atlantic Fertilizer Co., Stock Exchange Bldg., Baltimore, Md.

Rawson & Hodge's Potato Mixture,
Rawson & Hodge's Garden Fertilizer,
Rawson & Hodge's Peerless Brand,
Rawson & Hodge's Corn and Grain,
Fine Ground Bone,
Atlantic Dissolved Phosphate,
Atlantic Nitrate of Soda,
Atlantic Muriate of Potash,

Baltimore Pulverizing Co., Baltimore, Md.

Market Garden,
Quality Brand,

Beach Soap Co., Lawrence, Mass.

Beach's Top Dressing Fertilizer,
Beach's Seeding Down Fertilizer,
Beach's Market Garden Fertilizer,
Beach's Advance Fertilizer,
Beach's Reliance Fertilizer,
Beach's Lawn Dressing,
Beach's Fertilizer Bone.

Berkshire Fertilizer Co., Bridgeport, Conn.

Long Island Special,
Grass Special,
Tobacco Special with Carbonate of Potash,
Complete Fertilizer,
Potato and Vegetable Phosphate,
Ammoniated Bone Phosphate,
Economical Grass Fertilizer,
Complete Tobacco Fertilizer.

Charles M. Bolles, East Pepperell, Mass.

Nissittissit Brand.

Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.

Bowker's Highly Nitrogenized Mixture,
Bowker's Blood, Bone and Potash,
Bowker's Complete Alkaline Tobacco Grower with Sulfate Potash,
Bowker's Early Potato Manure,
Bowker's Lawn and Garden Dressing,
Bowker's Onion Fertilizer (Potash from Sulfate),
Bowker's Market Garden Fertilizer,
Bowker's Potato and Vegetable Fertilizer,
Bowker's Soluble Animal Fertilizer,
Bowker's High Grade Fertilizer,
Bowker's Cranberry Phosphate,
Bowker's Corn, Grain and Grass,
Bowker's Fish and Potash, Square Brand,
Bowker's Hill and Drill Phosphate,
Bowker's Potato and Vegetable Phosphate,
Bowker's Farm and Garden Phosphate,
Bowker's Corn Phosphate,
Bowker's Bone and Wood Ash Fertilizer,
Bowker's Bristol Fish and Potash,
Bowker's Ammoniated Food for Flowers,
Bowker's 10% Manure,
Bowker's Sure Crop Phosphate,
Bowker's Potash Bone,
Bowker's Gloucester Fish and Potash,
Bowker's Tobacco Ash Elements, (Potash from Sulfate),
Bowker's Fresh Ground Bone,
Bowker's Acid Phosphate,
Bowker's Nitrate of Soda,

Bowker's Sulfate of Ammonia,
Bowker's Dried Blood,
Bowker's Fine Ground Bone Tankage,
Bowker's Muriate of Potash,
Bowker's High Grade Sulfate of Potash,
Bowker's Kainit,
Bowker's Canadian Hardwood Ashes,
Bowker's Dry Ground Fish,
Bowker's Basic Slag,
Bowker's Pulverized Sheep Manure,
Stockbridge's Tobacco Manure (Potash from Sulfate),
Stockbridge's Special Manure for Top Dressing and Forcing,
Stockbridge's Special for Potatoes and Vegetables,
Stockbridge's Special for Corn and all Grain Crops,
Stockbridge's Special for Seeding Down, Permanent Dressing and Legumes.

Joseph Breck & Sons Corporation, 51-52 N. Market St., Boston, Mass.

Breck's Lawn and Garden Dressing,
Breck's Market Garden Manure,
Breck's Ram's Head Brand Sheep Manure.

F. W. Brodé & Co., 40 S. Front St., Memphis, Tenn.

Owl Brand Cottonseed Meal.

Buckeye Cotton Oil Co., Cincinnati, O.

Buckeye Cottonseed Meal.

Buffalo Fertilizer Co., William St., Buffalo, N. Y.

Fish Guano,
Farmers' Choice,
New England Special,
Celery and Potato Special,
Vegetable and Potato,
High Grade Manure,
Buffalo Tobacco Producer,
Top Dresser,
Bone Meal.

The E. D. Chittenden Co., Bridgeport, Conn.

Chittenden's Complete Tobacco and Onion Grower,
Chittenden's Grain and Vegetable,
Chittenden's Potato and Grain,
Chittenden's Connecticut Tobacco Grower,
Chittenden's Tobacco Special,
Chittenden's Grass and Grain,
Chittenden's Fish and Potash.

Clay & Son, Stratford, London, Eng.

Clay's London Fertilizer.

The Coe Mortimer Co., 51 Chambers St., New York City.

E. Frank Coe's Celebrated Special Potato Fertilizer,
E. Frank Coe's Columbian Corn and Potato,
E. Frank Coe's Complete Manure with 10% Potash,
E. Frank Coe's Excelsior Potato Fertilizer,
E. Frank Coe's Famous Prize Brand Grain and Grass Fertilizer,
E. Frank Coe's Gold Brand Excelsior Guano,
E. Frank Coe's High Grade Ammoniated Bone Superphosphate,
E. Frank Coe's New Englander Corn and Potato Fertilizer,
E. Frank Coe's Red Brand Excelsior Guano,
E. Frank Coe's Special Grass Top Dressing
E. Frank Coe's XXV Ammoniated Bone Phosphate,
E. Frank Coe's Double Strength Potato Manure,
E. Frank Coe's High Grade Soluble Phosphate,
E. Frank Coe's Ground Animal Tankage,
E. Frank Coe's Peruvian Vegetable Grower,
E. Frank Coe's Peruvian Market Gardeners' Fertilizer,
E. Frank Coe's Peruvian Grass Top Dressing,
E. Frank Coe's Peruvian Tobacco Fertilizer,
B. M. Warner's Special Onion Fertilizer,
Cowls' Special 4-6-6,
Cowls' Special 4-7-8,
Nitrate of Soda,
Muriate of Potash,
Sulfate of Potash,
Thomas Phosphate Powder (Basic Slag),

S. P. Davis, Little Rock, Ark.

Good Luck Brand Cottonseed Meal.

John C. Dow Co., 13-14 Chatham St., Boston, Mass.

Dow's Pure Ground Bone.

Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.

IMP Plant Food.

Essex Fertilizer Co., 39 N. Market St., Boston, Mass.

Essex A1 Superphosphate,
Essex Lawn Dressing,
Essex Grain and Grass Fertilizer,
Essex Grass and Top Dressing,
Essex Tobacco Starter and Grower,
Essex Potato Grower with 10% Potash,
Essex XXX Fish and Potash,
Essex Market Garden and Potato Manure,
Essex Complete for Potatoes, Roots and Vegetables,
Essex Complete for Corn, Grain and Grass,
Essex Special Potato Phosphate,

Finch, Pruyn & Co., Glens Falls, N. Y.

Lime Ashes.

German Kali Works, Continental Bldg., Baltimore, Md.

Kainit,
Acid Phosphate,
Manure Salt,
Muriate of Potash,
Sulfate of Potash,
Nitrate of Soda,

W. R. Grace & Co., Hanover Sq., New York City.

Nitrate of Soda.

Chas. W. Hastings, 76 Center St., Dorchester, Mass.

Ferti-Flora.

J. P. Hawes, 88 Broad St., Boston, Mass.

Nitrate of Soda.

Thomas Hersom & Co., New Bedford, Mass.

Pure Bone Meal,
Meat and Bone.

Home Soap Co., 103 Webster St., Worcester, Mass.

Ground Bone.

Humphreys, Godwin & Co., Memphis, Tenn.

Dixie Brand Cottonseed Meal.

John Joynt, Lucknow, Ontario, Canada.

Pure Unleached Hardwood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.

Lister's High Grade Special for Spring Crops,
Lister's Success Fertilizer,
Lister's Special Corn Fertilizer,
Lister's Special Potato Fertilizer,
Lister's Potato Manure,
Lister's Special Tobacco Fertilizer,
Lister's Grain and Grass Fertilizer,
Lister's 10% Potato Grower,
Lister's Standard Grass Fertilizer,
Lister's Complete Tobacco Manure,
Lister's Ground Tankage 6 & 30,
Lister's Nitrate of Soda,
Lister's High Grade Sulfate of Potash.

Jas. E. McGovern, Andover, Mass.

Andover Animal Fertilizer.

Mapes' Formula and Peruvian Guano Co., 143 Liberty St., New York City.

Mapes' Potato Manure,
Mapes' Tobacco Starter Improved,
Mapes' Tobacco Manure Wrapper Brand,
Mapes' Fruit and Vine Manure,
Mapes' Economical Potato Manure,
Mapes' Vegetable or Complete Manure for Light Soils,
Mapes'Average Soil Complete Manure,
Mapes' Cauliflower and Cabbage Manure,
Mapes' Corn Manure,
Mapes' Grass and Grain Spring Top Dressing
Mapes' Lawn Top Dressing,
Mapes' Complete Manure "A" Brand,
Mapes' Dissolved Bone,
Mapes' Complete Manure for General Use,
Mapes' Cereal Brand,

Mapes' Top Dresser Improved, Full Strength,

Mapes' Tobacco Ash Constituents,
Mapes' Complete Manure 10% Potash,
Mapes' Grain Brand,
Mapes' Nitrate of Soda,
Mapes' Double Manure Salt,
Mapes' High Grade Sulfate of Potash,
Mapes' Complete Manure for Heavy Soils.

The Geo. E. Marsh Co., Lynn, Mass.

Marsh's Pure Ground Bone,
Marsh's Dry Ground Tankage.

D. M. Moulton, Monson, Mass.

Ground Bone.

Geo. L. Munroe & Sons, Oswego, N.Y.

Pure Unleached Wood Ashes,

National Fertilizer Co., 92 State St., Boston, Mass.

Chittenden's Complete Corn and Grain Fertilizer,
Chittenden's Fine Ground'Bone,
Chittenden's Fish and Potash,
Chittenden's XXX Fish and Potash,
Chittenden's Market Garden Fertilizer,
Chittenden's Ammoniated Bone Phosphate,
Chittenden's High Grade Special Tobacco Fertilizer,
Chittenden's Complete Root Fertilizer,
Chittenden's Potato Phosphate,
Chittenden's Complete Tobacco Fertilizer,
Chittenden's Connecticut Valley Tobacco Grower,
Chittenden's Connecticut Valley Tobacco Starter,
Chittenden's Tobacco Special with Carbonate Potash,
Chittenden's Tobacco Special with Sulfate of Potash,
Chittenden's Dry Ground Fish,
Chittenden's Complete Grass Fertilizer
Chittenden's Eureka Potato Fertilizer,
Chittenden's High Grade Top Dressing,
Chittenden's Double Manure Salt,
Chittenden's High Grade Sulfate of Potash,
Chittenden's Muriate of Potash,
Chittenden's Nitrate of Soda,
Chittenden's Plain Superphosphate, (12% Available Phosphoric Acid),
Chittenden's Plain Superphosphate, (16% Available Phosphoric Acid),

Natural Guano Co., Aurora, Ill.

"Sheep's Head Brand" Pulverized Sheep Manure.

New England Fertilizer Co., 40 A North Market St., Boston, Mass.

New England Corn Phosphate,
New England Superphosphate,
New England Potato Fertilizer,
New England High Grade Potato Fertilizer,
New England Corn and Grain Fertilizer,
New England Top Dressing for Grass and Grain,
New England Complete Manure.

New England Mineral Fertilizer and Chemical Co., 19 Exchange Place, Boston, Mass.

The New Mineral Fertilizer.

Nitrate Agencies Co., 24-26 Stone St., New York City.

Nitrate of Soda,
Muriate of Potash,
Sulfate of Potash,
Acid Phosphate,
Peruvian Guano.

W. C. Nothern, Little Rock, Ark.

Bee Brand Cottonseed Meal.

Olds & Whipple, Hartford, Conn.

Olds & Whipple's Complete Onion Fertilizer,
Olds & Whipple's Complete Tobacco Fertilizer,
Olds & Whipple's Dry Ground Fish,
Olds & Whipple's Complete Grass Fertilizer,
Olds & Whipple's Complete Corn and Potato,
Olds & Whipple's High Grade Potato,
Olds & Whipple's Fish and Potash,
Olds & Whipple's Castor Pomace,
Olds & Whipple's Tankage,
Olds & Whipple's Acid Phosphate,
Olds & Whipple's Sulfate of Potash-Magnesia,

Olds & Whipple's Muriate of Potash,
Olds & Whipple's Nitrate of Soda,
Olds & Whipple's Cottonseed Meal,
Olds & Whipple's Bone Meal,
Olds & Whipple's High Grade Sulfate of Potash.

Parmenter & Polsey Fertilizer Co., 40 N. Market St., Boston, Mass.

Parmenter & Polsey Plymouth Rock Brand,
Parmenter & Polsey Special Potato Fertilizer,
Parmenter & Polsey Potato Fertilizer,
Parmenter & Polsey A. A. Brand,
Parmenter & Polsey Potato Grower,
Parmenter & Polsey Star Brand Superphosphate,
Parmenter & Polsey Aroostook Special,
Parmenter & Polsey Grain Grower,
Parmenter & Polsey Maine Potato Fertilizer,
Parmenter & Polsey Lawn Dressing.

Pulverized Manure Co., 28 Exchange St., Chicago, Ill.

Wizard Brand Pulverized Manure,

Geo. B. Robinson, Jr., 18 Broadway, New York City.

Robin Brand Cottonseed Meal.

Robinson Glue Co., Gloucester, Mass.

Dry Ground Fish Scrap.

The Rogers Manufacturing Co., Rockfall, Conn.

All Round Fertilizer,
Complete Potato and Vegetable,
High Grade Corn and Onions,
Fish and Potash,
High Grade Oats and Top Dressing,
High Grade Tobacco and Potato,
High Grade Grass and Grain,
High Grade Tobacco Grower,
High Grade Tobacco,
Pure Knuckle Bone Flour,
Pure Fine Bone,
Nitrate of Soda,
Muriate of Potash,
High Grade Sulfate of Potash,
Acid Phosphate,
Ground Fish.

The Rogers & Hubbard Co., Middletown, Conn.

Hubbard's Bone Base Complete Phosphate,
Hubbard's Bone Base Potato Phosphate,
Hubbard's Bone Base New Market Garden Phosphate,
Hubbard's Bone Base Soluble Corn and General Crops,
Hubbard's Bone Base Soluble Potato Manure,
Hubbard's Bone Base Soluble Tobacco Manure,
Hubbard's Bone Base Grass and Grain Fertilizer,
Hubbard's Bone Base Oats and Top Dressing,
Hubbard's Bone Base Pure Raw Knuckle Bone Flour,
Hubbard's Bone Base Strictly Pure Fine Bone,

Ross Bros. Co., 88 Front St., Worcester, Mass.

High Grade Potato Fertilizer,
Corn, Grass and Grain,
Potato and Vegetable Fertilizer,
Odorless Lawn Dressing.

N. Roy & Son, S. Attleboro, Mass.

Roy's Complete Animal Fertilizer,

Sanderson Fertilizer and Chemical Co., New Haven, Conn.

Sanderson's Formula "A",
Sanderson's Formula "B",
Sanderson's Top Dressing for Grass and Grain,
Sanderson's Potato Manure,
Sanderson's Special with 10% Potash,
Sanderson's Corn Superphosphate,
Sanderson's Atlantic Coast Bone, Fish and Potash,
Sanderson's Blood, Bone and Meat,
Sanderson's Fine Ground Bone,
Sanderson's Fine Ground Fish,
Sanderson's Nitrate of Soda,
Sanderson's Muriate of Potash,
Sanderson's High Grade Sulfate of Potash,
Sanderson's Sulfate of Potash-Magnesia,
Sanderson's Basic Slag Phosphate,
Sanderson's Plain Superphosphate,
Sanderson's Castor Meal.

M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.

Swift-Sure Superphosphate for General Use,
Swift-Sure Superphosphate for Potatoes,
Swift-Sure Bone Meal.

J. E. Soper Co., Chamber of Commerce, Boston, Mass.

Pioneer Cottonseed Meal.

W. Newton Smith, Baltimore, Md.

Dirigo Brand Cottonseed Meal.

Springfield Rendering Co., Springfield, Mass.

Raw Ground Bone,
Tankage,
Steamed Bone.

Thomas L. Stetson, Randolph, Mass.

Pure Ground Bone.

Chas. Stevens, Napanee, Ontario, Can.

"Beaver Brand" Hardwood Ashes.

George Stevens, Peterborough, Ontario, Can.

Canada Unleached Hardwood Ashes.

E. P. Swan Co., S. Deerfield, Mass.

Lime Ashes.

Swift's Lowell Fertilizer Co., 40 N. Market St., Boston, Mass.

Swift's Lowell Empress Brand,
Swift's Lowell Bone Fertilizer,
Swift's Lowell Potato Manure,
Swift's Lowell Animal Brand,
Swift's Lowell Potato Phosphate,
Swift's Lowell Superior with 10% Potash,
Swift's Lowell Special Grass Mixture,
Swift's Lowell Potato Grower,
Swift's Lowell Special Potato,
Swift's Lowell Sterling Phosphate,
Swift's Lowell Market Garden Manure,
Swift's Lowell Ground Bone,
Swift's Lowell Tankage,
Swift's Lowell Nitrate of Soda,
Swift's Lowell Muriate of Potash,
Swift's Lowell Acid Phosphate,
Swift's Lowell Lawn Dressing,
Swift's Lowell Dissolved Bone and Potash,
Swift's Lowell Perfect Tobacco Manure,
Swift's Lowell Seeding Down Fertilizer,
Swift's Lowell High Grade Sulfate of Potash,
Swift's Lowell Dissolved Bone Black,
Swift's Lowell Special Corn and Vegetable Manure,
Swift's Lowell Cereal Brand Fertilizer,
Swift's Lowell Dried Blood,
Swift's Lowell Sulfate of Ammonia.

Wm. Thomson & Sons, Ltd., Tweed Vineyard, Clovenfords, Scotland.

Thomson's Vine, Plant and Vegetable Manure,
Thomson's Special Chrysanthemum and Top Dressing.

20th Century Specialty Co., 26 Brattle St., Boston, Mass.

Ready Complete 20L Fertilizer, No. 1.

A. L. Warren, Northboro, Mass.

Warren's Pure Ground Bone.

Whitman & Pratt Rendering Co., Lowell, Mass.

Corn Success,
All Crop,
Potato Manure,
Potato Plowman,
Vegetable Grower,
Potash Special,
Ground Bone,
Sulfate of Potash,
Muriate of Potash,
Nitrate of Soda,
Sulfate of Ammonia,
Dissolved Bone Black,
Acid Phosphate,
Dried Blood,
Fine Ground Tankage.

Wilcox Fertilizer Co. Mystic, Conn.

Wilcox Potato, Onion and Vegetable Phosphate,
Wilcox Grass Fertilizer,
Wilcox High Grade Tobacco Special,
Wilcox 4-8-10 Fertilizer,
Wilcox Complete Bone Superphosphate
Wilcox High Grade Fish and Potash,

Wilcox Potato Fertilizer,
Wilcox Fish and Potash,
Wilcox Special Superphosphate,
Wilcox Nitrate of Soda,
Wilcox Dry Ground Fish Guano,
Wilcox Dry Ground Acidulated Fish,
Wilcox High Grade Tankage,
Wilcox Pure Ground Bone,
Wilcox Ground Steamed Bone,
Wilcox Acid Phosphate,
Wilcox Basic Slag Meal,
Wilcox Muriate of Potash,
Wilcox High Grade Sulfate of Potash.

S. Winter Co., Brockton, Mass.
Winter's Pure Ground Bone.

A. H. Wood & Co., Framingham, Mass.
Wood's B. B. Fertilizer,
Wood's S. P. Fertilizer,
Wood's 777 Fertilizer,

J. M. Woodard, Greenfield, Mass.
Woodard's Unground Tankage.

Worcester Rendering Co., Auburn, Mass.
Ground Tankage.

Fertilizers Collected.

The samples were taken by our regular inspector, Mr. Jas. T. Howard assisted by Mr. E. C. Hall and Mr. E. L. Winn. An effort has been made in all cases to get representative samples. At least 10 per cent of the bags found present have been sampled by means of an instrument taking a core the entire length of the bag. In no case have there been less than ten bags of each brand sampled wherever that number has been found in stock. In case of bulky mixed goods which might have a tendency to mechanical separation in transit, a sample has been taken from both sides of the bag so that in case any of the fine, heavier chemicals such as potash salts had sifted through the more bulky portion, the sample taken would be more representative.

Whenever possible, samples of the same brand have been collected in various parts of the state, the object being to sample as large a proportion of the tonnage shipped into the state as possible. In most cases where duplicate samples have been drawn, a composite made up of equal weights of the various samples served for the analysis. In some instances several analyses have been made of the same brand; this has been done at the request of large consumers who have bought heavy shipments of some special brand.

It is difficult to tell how large a per cent of the total tonnage shipped into the state has been sampled. An effort was made at the end of the season of 1910 to ascertain approximately the number of tons sold, but some of the larger manufacturers refused to furnish the data. As complete and extensive a collection as pos-

sible has been made in the limited time at our disposal and with the means available for the work.

During the season 116 towns were visited and 1063 samples representing 519 distinct brands were drawn from stock found in the possession of 284 different agents, as against 897 samples and 487 distinct brands collected and examined in 1910. Some of these brands represent private formulas which would have been sent to the station for analysis by the consumer had they not been taken by the inspectors. Arrangements can be made in most cases to have large shipments of private formulas sampled by one of our regular collectors, provided notification is given sufficiently early in the season so that the various places may be visited while the collectors are in that vicinity.

Fertilizers Analyzed.

Six hundred and sixty-two analyses have been made in connection with the 1911 fertilizer inspection.

The analyses made may be grouped as follows:

Complete fertilizers	427
Fertilizers furnishing phosphoric acid and potash, such as ashes, etc.	18
Ground bones, tankage and fish	73
Nitrogen compounds, including the mineral forms of nitrogen; also the various organic forms both animal and vegetable	69
Potash compounds	50
Phosphoric acid compounds	25
Total	662

Trade Values of Fertilizing Ingredients.

The following table of trade values was adopted by the Experiment Stations of New England, New York and New Jersey at a conference held the first of March, 1911, and has served as the basis of valuing the fertilizers published in this bulletin. The schedule for 1910 is also given for comparison.

	Cents per pound. 1910.	1911.
Nitrogen.		
In ammonia salts	16	16
In nitrates	16	16
Organic nitrogen in dry and fine ground fish, meat and blood	20	23
Organic nitrogen in fine* bone, tankage and mixed fertilizers	20	20
Organic nitrogen in coarse* bone and tankage	15	15
Organic nitrogen in cottonseed meal, castor pomace, linseed meal, etc.,	—	21
Phosphoric Acid.		
Soluble in water	4½	4½
Soluble in neutral ammonium citrate solution (reverted phosphoric acid) **	4	4
In fine* ground bone and tankage	4	4
In coarse* bone, tankage and ashes	3½	3½
In cottonseed meal, linseed meal and castor pomace	3½	4
Insoluble (in neutral ammonium citrate solution) in mixed fertilizers	2	2
Potash.		
As sulfate, free from chlorides	5	5
As muriate (chloride)	4¼	4¼
As carbonate	8	8
In cottonseed meal, castor pomace, linseed meal, etc.	—	5

The basis for these trade values was the average wholesale quotations of chemicals and raw materials as taken from the commercial publications during the six months preceding March 1, 1911, plus about 20 per cent. They are supposed to represent the average cost per pound for cash at retail of nitrogen, phosphoric acid and potash as found in unmixed fertilizing material in the principal markets in New England and New York. There has been but little change in the cost of the various forms of plant food, with the exception of the better forms of organic nitrogen which have shown a considerable advance as compared with the previous year.

In connection with the valuations which are published in the tables of analysis there will be found the average retail cash price and percentage of difference. The usual care has been exercised in

*Fine and medium bone and tankage are separated by a sieve having circular openings 1-50 of an inch in diameter. Valuations of these materials are based upon degree of fineness as well as upon composition.

**Dissolved by a neutral solution of ammonium citrate, sp. gr. 1.09, in accordance with method adopted by Association of Official Agricultural Chemists.

procuring the agent's cash price through correspondence, and in most cases the prices published have been verified over the agent's signature. The percentage difference is published in each case to conform to the law. Its significance has been so often discussed in previous bulletins that it seems unnecessary to enlarge upon it at this time. It simply represents in percentages the excess of the average retail cash price over the commercial value in raw materials of the plant food in the fertilizer.

Unmixed Fertilizing Material.

Ground Bone.

Thirty-three samples of ground bone have been collected and analyzed. Ten were found deficient in phosphoric acid and five in nitrogen. The average retail cash price for ground bone has been $31.32 per ton, the average valuation $29.80 and the percentage difference 5.10. Two of the brands analyzed showed a commercial shortage of 50 cents or over per ton:

Buffalo Fertilizer Co., Bone Meal No. 859. Nitrogen found 2.47%, guaranteed 2.9%; total phosphoric acid found 22.96%, guaranteed 22%.

Geo. E. Marsh & Co., Marsh's Pure Bone Meal, No. 333-368. Nitrogen found 2.68%, guaranteed 2.48%; total phosphoric acid found 26.12%, guaranteed 28%.

Ground Tankage.

Eighteen samples of tankage have been analyzed; three were found deficient in nitrogen and five in phosphoric acid. The average retail cash price per ton was $34.14, the average valuation per ton $32.69 and the percentage difference 4.43. Nitrogen in fine tankage has cost on the average 20.89 cents; nitrogen in coarse tankage has cost 15.65 cents per pound. Three samples have shown a commercial shortage of over 50 cents per ton. They are as follows:

Bowker Fertilizer Co., Ground Tankage No. 220-807. Nitrogen found 5.12%, guaranteed 4.94%; total phosphoric acid found 11.45%, guaranteed 13.73%.

Coe-Mortimer Co., Tankage No. 249. Nitrogen found 3.75%, guaranteed 4.96%; total phosphoric acid found 13.29%, guaranteed 13.70%.

Another sample said by the Coe-Mortimer Co. to be from the same lot, was shipped to the Agricultural Department of the Experiment Station; this sample tested 5.13% nitrogen and 14.40% phosphoric acid.

Springfield Rendering Co., Ground Tankage No. 974-1028. Nitrogen found 7.03%, guaranteed 7.40%; total phosphoric acid found 11.46%, guaranteed 12%.

Dry ground Fish.

Twenty-two samples of dry ground fish have been examined; three were found deficient in nitrogen and two in phosphoric acid. The average retail cash price per ton was $41.90, the average valuation $42.71 and the percentage difference in excess 1.93. Nitrogen from dry ground fish has cost on the average 22.56 cents per pound. None of the brands showed a commercial shortage of over 50 cents per ton.

Sulfate of Ammonia.

Three samples of sulfate of ammonia have been analyzed and found well up to the guarantee. The average cost of a pound of nitrogen in this form has been 16.78 cents.

Nitrate of Soda.

Twenty-three samples of nitrate of soda have been analyzed and three were found deficient in nitrogen. The average cost of nitrogen in this form has been 16.19 cents per pound. The brands showing a commercial shortage of 50 cents or over per ton were as follows:

Atlantic Fertilizer Co., Nitrate of Soda No. 398. Nitrogen found 15.50%, guaranteed 15.82%.

J. P. Hawes, Nitrate of Soda No. 637-892. Nitrogen found 15.3%, guaranteed 15.65%.

Wilcox Fertilizer Works, Nitrate of Soda No. 285-290. Nitrogen found 14.7%, guaranteed 15%.

Dried Blood.

Four samples have been examined which, with one exception, showed overruns in nitrogen. The pound of nitrogen from blood has cost 23.29 cents.

Castor Pomace.

Four samples have been analyzed. The average cost of nitrogen in this form has been 26.11 cents per pound. The following brand showed a commercial shortage of over 50 cents per ton:

Sanderson Fertilizer and Chemical Co., Castor Pomace No. 972-1022. Nitrogen found 5.73% and 5.45%; guaranteed 6.50%.

Cottonseed Meal.

Twenty-three samples have been examined, all of which were purchased as a nitrogen source for tobacco. Nitrogen from this source has cost on the average 23.08 cents per pound. Six samples have shown a nitrogen deficiency which has, in three cases, amounted to 50 cents or more per ton. They are as follows:

S. P. Davis, Cottonseed Meal No. 24. Nitrogen found 6.32%, guaranteed 6.50%.

Humphrey's, Godwin & Co., No. 26. Nitrogen found 6.43%, guaranteed 6.56%. No. 27. Nitrogen found 6.25%, guaranteed 6.56%.

Potash Compounds.

High Grade Sulfate of Potash. Twenty-one samples have been examined and the potash guarantee was maintained in all but one instance. The pound of actual potash in this form has cost on the average 5.2 cents. Brand No. 887, licensed by the Whitman & Pratt Rendering Co., showed 39.04% potash, 48% being guaranteed. The company state that all of their potash was sold in original bags as imported.

Two cases of misbranding were discovered by our inspectors. Material put out by the Nitrate Agencies Company as High Grade Sulfate of Potash proved upon analysis to be Muriate of Potash. The sale of the material as sulfate of potash was discontinued and the material was properly labelled. The Nitrate Agencies Company have this to say concerning the matter:

"All of the potash which we sell is imported from Germany and is shipped as received in the original bags of the German Kali Works. Altho we license Muriate of Potash, Sulfate of Potash and Kainit, attaching our tags to the bags when shipping, thereby assuming the responsibility" the shipments in question "were branded Sulfate of Potash, 48% Actual Potash, and without examining the entire lot we shipped the goods according to the branding, as Sulfate of Potash. It is very evident that it was Muriate of Potash bagged in error from Germany in Sulfate of Potash bags, so that we cannot but feel that the circumstances surrounding the shipment of Muriate of Potash as Sulfate of Potash were beyond our control. As soon as the matter was called to our attention by the consignees we put forth every effort to rectify the matter, allowing them the full difference in value between muriate and sulfate of potash and shipping them some sulfate of potash from another lot." "We realize fully the seriousness of the error but we believe that under the circumstances you appreciate that it was beyond our normal control and that there was no intention on our part to substitute one material for another."

As the Nitrate Agencies Company are simply distributors of raw products and agricultural salts, it is readily seen how the mistake happened. Occasion was taken, however, to point out the seriousness of the error and that as the material was sold under their brand name, they were responsible for the delivery of proper material. We have the assurance of the company that shipments will be examined hereafter before forwarding.

Potash-Magnesia Sulfate. Six samples of potash-magnesia sulfate have been examined and all but two were found fully up to the guarantee. The pound cost of actual potash in this form has been 5.91 cents.

One sample put out by the Sanderson Fertilizer and Chemical Company was found seriously deficient in potash, containing only 23.72% when 26% was guaranteed. A further study revealed the presence of 31.61% of sand. A test for magnesia showed only 4.82% whereas a bona fide sample of potash-magnesia sulfate should contain between 13 and 14 per cent magnesium oxide. These results indicated that high grade sulfate of potash had been reduced by the addition of sand and kieserit and sold as potash-magnesia sulfate. Mr. Sanderson states concerning the matter that the potash salt was bought by the company as sulfate of potash-magnesia and sold in original packages to their customers; that if any adulteration took place it was before the material was shipped to this country; that the potash salt was purchased through the International Agricultural Corporation, but their contract with these people has become cancelled by action of the German Government; that very little of the material has been sold unmixed and never as double sulfate of potash, the guarantee being simply *Sulfate of Potash*; and that the rebate due for the deficiency of potash will be made to customers who purchased the material.

Two other cases of a similar character have been detected, the material having been shipped through Olds & Whipple of Hartford, Conn. These cases, however, did not show a shortage in potash, a considerable overrun being recorded in each case. They showed 30.33% and 25.32% of sand respectively, the magnesia being about one-half as much as is usually found in the ordinary potash-magnesia salt. The Olds & Whipple Company claim that the material was sold by them in original bags as received from Germany, that the material was purchased as bona fide potash-magnesia sulfate and in proof of this sent their original contract with the German Kali Works. The matter was then taken up with the German Kali Works who made a complete investigation and reported that one of the mines in Germany had been detected in reducing high grade sulfate of potash with sand and kieserit and shipping the same as sulfate of potash-magnesia whenever heavy orders for this salt came in that could not be readily filled with the bona fide double manure salt. A further statement was made that the German Kali Works did not favor the practice and shipments of this material when discovered had been returned and the mine had been heavily fined for the practice. The German Kali Works have offered to compensate the buyers by allowing them the value of the deficient magnesia less the value of the overrun in potash.

Muriate of Potash.

Eighteen samples of muriate of potash have been examined and three were found deficient in potash. The pound of actual potash as muriate or chloride has cost on the average 4.43 cents. Two

brands have shown a commercial shortage amounting to over 50 cents per ton. They are:

Armour Fertilizer Works, Muriate of Potash No. 978. Potash found 41.88%, guaranteed 48%.

Bowker Fertilizer Company, Muriate of Potash No. 227-266-488. Potash found 47.40%, guaranteed 49%.

It has been pointed out through correspondence with Dr. H. A. Huston, Secretary of the German Kali Works, that muriate of potash has given some trouble due to its tendency to absorb moisture from the atmosphere. This would cause the material to weigh considerably more and the purchaser would get all of the potash he was entitled to, and yet the analysis would show an apparent shortage. A test made on muriate of potash shipped by the German Kali Works showed an apparent shortage of .32% potash. In order to test the statement made by the Potash Syndicate, at our request weights of all the unbroken packages of muriate of potash were made by a local agent, who found them to vary between 206 and 207 pounds. According to Dr. Husron an empty bag will weigh about 1¼ pounds and the sack and contents will weigh 201¼ pounds when it leaves Germany. This would indicate an absorption of moisture, and according to our analysis which gave 49.68% potash would show that each bag contained 102.59 pounds of actual potash, equivalent to 51.29% assuming, of course, that the salt carried the same moisture content as when it left the mines in Germany. The tendency of this salt to absorb moisture may account in a measure for the low tests shown on the Bowker brand mentioned above, which had a moisture content of 1.85%.

Kainit.

Three samples of kainit have been analyzed and found well up to the guarantee. The pound of actual potash from kainit has cost 4.34 cents.

Phosphoric Acid Compounds.

Dissolved Bone Black.

Two samples of dissolved bone black have been analyzed and both showed a commercial shortage of over 50 cents per ton. The pound of available phosphoric acid from this source has cost on the average 6.11 cents. The two brands are:

The American Agricultural Chemical Co., Brand No. 232. Soluble phosphoric acid found 10.91%, guaranteed 13%; reverted phosphoric acid found 1.82%, guaranteed 2%; insoluble phosphoric acid found .92%, guaranteed 1%. The company procured and analyzed the duplicate sample left with the agent by our inspectors and found in addition to the phosphoric acid present 3.10% potash and .3% nitrogen. A statement from the factory

superintendent was made to the effect that the stock from which this lot was shipped ran over 15% available phosphoric acid, but that in making the shipment, which consisted of only about one ton, it was remilled through a mill which evidently was not properly cleaned after milling complete goods.

The other brand showing a shortage was put out by the Swift's Lowell Fertilizer Co., Brand No. 344. It tested 13.68% available phosphoric acid, 15% being guaranteed.

Acid Phosphate. Fifteen samples of acid phosphate have been examined and all but two were found well up to the minimum guarantee. No commercial shortage of over 50 cents a ton occurred. The pound of available phosphoric acid from acid phosphate has cost 5.44 cents.

Basic Slag Phosphate. Seven samples have been analyzed and all were found well up to the guarantee. The pound of available phosphoric acid from basic slag, as determined by Wagner's Method, has cost on the average 5.12 cents.

Mixed Complete Fertilizers.

Study of Grades of Fertilizer. The grouping of the complete fertilizers into three different grades furnishes a convenient means of showing the superior advantages to be derived from the purchase of *high grade fertilizers*. In the tables below the high grade fertilizers are represented by those brands having a commercial value of \$24 or over per ton; the medium grade by those which value between \$18 and \$24; and the low grade those which value \$18 or less per ton.

Table showing average cash price, commercial value, money difference between cash price and valuation, and percentage difference of the three grades of fertilizer.

	High Grade		Medium Grade		Low Grade	
	1910	1911	1910	1911	1910	1911
Average Cash Price per ton....	\$38.40	\$40.87	\$33.51	\$35.08	\$27.80	\$29.64
Average Ton Valuation........	\$28.81	\$28.89	\$21.04	\$21.04	\$15.61	\$15.37
Average Money Difference.....	\$ 9.59	\$11.98	\$12.47	\$14.04	\$12.19	\$14.27
Percentage Difference	33.28	41.47	59.26	66.73	78.08	92.84

Table showing the average composition of the three grades of fertilizers.

GRADE	Number of Brands	Per Cent of Whole Number	Per Cent of Nitrogen	Per Cent of Phosphoric Acid: Soluble	Per Cent of Phosphoric Acid: Reverted	Per Cent of Phosphoric Acid: Available	Per Cent of Potash	Lbs. of Available Plant Food in 100 Lbs. of Fertilizer
High	153	46.22	4.12	4.00	3.32	7.32	7.64	19.08
Medium	103	31.12	2.61	2.93	2.94	5.87	5.12	13.60
Low	75	22.66	1.66	4.53	2.82	7.35	2.90	11.91

What is shown by the above tables:

(1). That the average ton price for the three grades of fertilizer has been nearly $2.00 more for 1911 than for the previous year, altho but little difference is noticed in the average valuation per ton for the two years.

(2). That the percentage excess of the selling price over the valuation in the low grade fertilizers is about 2¼ times more than it is in the high grade goods and over 1½ times more than in the medium grade fertilizers.

(3). That with a 38 per cent advance in price over the low grade fertilizer, the high grade furnishes about 88 percent increase in commercial value.

(4). The average high grade fertilizer with a 16.5 percent advance in price over the medium goods, furnishes 47.6 percent more plant food and 37.3 percent increase in commercial value.

(5). That with a 38 percent advance in price over the low grade fertilizer, the high grade furnishes more than 60 percent increase in available plant food.

(6). A ton of the average high grade fertilizer furnishes 49.2 lbs. more nitrogen and 94.8 lbs. more of actual potash than does a ton of the low grade goods.

(7). A ton of the average high grade fertilizer furnishes 30.2 lbs. more nitrogen and 50.4 lbs. more potash than does a ton of the medium grade goods.

Table showing the comparative pound cost of nitrogen, potash and phosphoric acid in its various forms in the three grades of fertilizer.

ELEMENT	Low Grade Fertilizer	Medium Grade Fertilizer	High Grade Fertilizer
Nitrogen	38.6 cts.	33.4 cts.	28.3 cts.
Potash (as Muriate)	8.2 "	7.1 "	6.0 "
Soluble Phosphoric Acid	8.7 "	7.5 "	6.4 "
Reverted Phosphoric Acid	7.7 "	6.7 "	5.7 "
Insoluble Phosphoric Acid	3.9 "	3.3 "	2.8 "

This table shows:

(1). That the purchase of high grade fertilizers in place of low grade goods has saved over 10 cents on every pound of nitrogen and over 2 cents on every pound of potash and phosphoric acid purchased.

(2). That the purchase of high grade fertilizers in place of medium grade goods has saved over 5 cents on every pound of nitrogen and over 1 cent on every pound of potash and phosphoric acid.

(3). Taking the average analysis of the high grade fertilizer as a basis the purchase of the high grade in place of the low grade goods would mean a saving of $14.23 on every ton purchased; the purchase of the high grade in place of the medium grade would mean a saving of $7.12 on every ton purchased.

(4). About 54% of the number of brands sold in Massachusetts are classed as medium or low grade fertilizers. Assuming that the tonnage of these goods was as large as for the high grade brands, there would have been a tremendous saving to the Massachusetts farmer had he bought only high grade fertilizer.

(5). The purchaser of fertilizers should look to the guaranteed analysis and remember that he is buying pounds of plant food as well as tons of fertilizer. He should know the form and about the proportion of the various elements of plant food and should purchase the brand which sells for the least money which comes nearest fulfilling his requirements.

(6). Everyone should consider and profit by the lessons taught by the above data.

Summary of results of analyses of the complete fertilizers as compared with the manufacturers' guarantee.

MANUFACTURER.	No. of Brands analyzed	No. with all three elements equal to guarantee	No. equal to guarantee in commercial value	No. with one element below guarantee	No. with two elements below guarantee	No. with three elements below guarantee
W. H. Abbott	2	—	1	—	2	—
American Agr'l Chem. Co.	73	30	69	29	14	—
Armour Fertilizer Works	13	8	13	5	—	—
Atlantic Fertilizer Co.	4	1	3	1	1	1
Baltimore Pulverizing Co.	2	1	2	—	1	—
Beach Soap Co.	6	3	5	1	1	1
Berkshire Fertilizer Co.	8	5	8	2	1	—
Bonora Chemical Co.	1	—	1	1	—	—
C. M. Bolles	1	1	1	—	—	—
Bowker Fertilizer Co.	32	10	26	16	6	—
Jos. Breck & Sons	3	3	3	—	—	—
Buffalo Fertilizer Co.	8	4	7	3	1	—
E. D. Chittenden Co.	6	3	5	2	1	—
Clay & Son	1	1	1	—	—	—
Coe-Mortimer Co	18	1	12	9	7	1
Eastern Chemical Co	1	1	1	—	—	—
Essex Fertilizer Co	11	1	8	9	1	—
C. W. Hastings	1	—	—	1	—	—
Lister's Agr'l Chem. Works	9	4	9	5	—	—
J. E. McGovern	1	1	1	—	—	—
Mapes' Form. & Per. Guano Co.	20	10	19	8	2	—
National Fertilizer Co.	17	7	14	7	3	—
Natural Guano Co.	1	1	1	—	—	—
New England Fertilizer Co.	7	1	3	3	2	1
New England Mineral Fert. Co.	1	1	1	—	—	—
Nitrate Agencies Co.	1	—	1	1	—	—
Olds & Whipple	6	3	6	3	—	—
Parmenter & Polsey Fert. Co.	10	1	5	6	2	1
Patrons' Co-op. Association	2	2	2	—	—	—
Pulverized Manure Co.	1	1	1	—	—	—
Rogers Manufacturing Co.	9	7	9	2	—	—
Rogers & Hubbard Co.	8	5	7	3	—	—
Ross Bros. Co.	4	1	4	2	—	—
N. Roy & Son	1	—	1	1	1	—
Sanderson Fert. and Chem. Co.	7	6	7	1	—	—
M. L. Shoemaker Co.	2	1	2	1	—	—
Swift's Lowell Fertilizer Co.	17	7	15	5	—	—
20th Century Specialty Co.	1	1	1	—	5	—
Wm. Thomson & Sons	2	1	2	1	—	—
Whitman & Pratt Rendering Co.	4	2	4	2	—	—
Wilcox Fertilizer Co.	9	6	9	3	—	—
A. H. Wood & Co.	3	1	3	2	—	—

The table on the opposite page shows:

(1). That 334 brands of registered complete fertilizers have been collected and analyzed.

(2). That 191 brands (57 per cent of the total number analyzed) fell below the manufacturer's guarantee in one or more elements.

(3). That 135 brands were deficient in one element.

(4). That 51 brands were deficient in two elements.

(5). That 5 brands were deficient in three elements.

(6). That 41 brands (over 12 per cent of the whole number analyzed) showed a commercial shortage; that is, when the overruns were used to offset shortages they did not show the amount in value of plant food as expressed by the smallest guarantee.

The deficiencies found were divided as follows:

96 brands were found deficient in nitrogen.

90 brands were found deficient in available phosphoric acid.

66 brands were found deficient in potash.

As compared with the previous year the guarantees have not been as generally maintained. Thirty-six more brands were found deficient in nitrogen and ten more in available phosphoric acid than for the season of 1910. The brands showing a commercial shortage were 17 more than during the previous year; in many cases, however, the commercial deficiency was small, amounting to less than 25 cents per ton.

Table showing commercial shortages (25 cents or over) in mixed complete fertilizers for 1910 and 1911.

Commercial Shortages	Number of Brands	
	1910.	1911.
Between $1.00 and $2.00 per ton	6	9
Under $1.00 not less than 25 cents per ton	18	17

Some brands have suffered serious deficiencies in some element of plant food without showing any commercial shortage, the deficiency being made up by an overrun of some other element. This is due probably either to carelessness or poor mixing rather than a disposition to furnish less plant food value than is called for in the guarantee. It furnishes a condition not to be commended, however, as the fertilizer may be rendered seriously out of balance.

Commercial Shortages.

The following brands have shown a commercial shortage of over 50 cents per ton, the value of overruns having in all cases been deducted from the total shortages.

W. H. Abbott, Holyoke, Mass.—Tobacco Fertilizer No. 175. Nitrogen found 3.97%, guaranteed 4%; available phosphoric acid found 7.40%, guaranteed 7%; potash found 7.04%, guaranteed 10%.

Mr. Abbott states that improper mixing must be responsible for the deficiencies as all of the materials were carefully weighed. The fertilizers were mixed by hand; a mechanical mixer is to be installed soon. It is also probable that a fluctuation in the composition of the raw products and chemicals may have been partly responsible for the trouble.

American Agricultural Chemical Co., Boston, Mass.—Special Grass and Garden Mixture, No. 477. Nitrogen found 8.48%, guaranteed 8.43%; available phosphoric acid found 4.70%, guaranteed 6.25%; potash found 7.85%, guaranteed 8.25%.

Darling's Blood, Bone & Potash, Nos. 685-809. Nitrogen found 3.59%, guaranteed 4.11%; available phosphoric acid found 7.10%, guaranteed 7%; potash found 6.89%, guaranteed 7%.

Atlantic Fertilizer Co., Baltimore, Md.—Garden Fertilizer, No. 526. Nitrogen found 2.24%, guaranteed 2.47%; available phosphoric acid found 7.40%, guaranteed 8%; potash found 3.72%, guaranteed 4%.

The manufacturers state that the goods were mixed on the basis of the purchase analysis which in a number of cases was not correct. In conclusion they say, "We now have a chemist in our employ who will keep an accurate test on all materials being received, and goods being shipped."

Bowker Fertilizer Co., Boston, Mass.—Sheep Manure, No. 584. Nitrogen found 2.12%, guaranteed 3.11%; total phosphoric acid found 1.84%, guaranteed 2.07%; potash found 4.16%, guaranteed 1.78%.

Ten per cent Manure, Nos. 714-820. Nitrogen found .96%, guaranteed .82%; available phosphoric acid found 5.33%, guaranteed 5%; potash found 8.83%, guaranteed 10%.

E. D. Chittenden Co., Bridgeport, Ct.—Grass and Grain, No. 214. Nitrogen found 3.83%, guaranteed 4.10%; available phosphoric acid found 6.40%, guaranteed 6%; potash found 4.77%, guaranteed 5%.

Coe-Mortimer Co., New York City.—Complete Manure with 10% Potash, No. 287. Nitrogen found 2.49%, guaranteed 2.47%; available phosphoric acid found 5.95%, guaranteed 6%; potash found 8.80%, guaranteed 10%.

Special Grass Top Dressing, No. 323. Nitrogen found 4.50%, guaranteed 4.94%; available phosphoric acid found 4.13%, guaranteed 4%; potash found 3.26%, guaranteed 3%.

Excelsior Potato, Nos. 362-760. Nitrogen found 2.23%, guaranteed 2.47%; available phosphoric acid found 6.55%, guaranteed 7%; potash found 7.54%, guaranteed 8%.

Standard Potato Fertilizer, No. 801. Nitrogen found 3.06%, guaranteed 3.30%; available phosphoric acid found 6.07%, guaranteed 6%; potash found 9.71%, guaranteed 10%.

The company contends that an overrun of plant food was provided for in every brand put out during the season and that they are unable to account for the deficiencies shown.

Another sample of the "Complete Manure with 10% Potash" and "Special Grass Top Dressing" was collected and analyzed later in the season. They tested as follows:

Complete Manure with 10% Potash. Nitrogen found 3.59%, guaranteed 2.47%; available phosphoric acid found 6.04%, guaranteed 6%; potash found 9.47%, guaranteed 10%.

Special Top Dressing. Nitrogen found 4.98%, guaranteed 4.94%; available phosphoric acid found 4.30%, guaranteed 4%; potash found 2.92%, guaranteed 3%.

Neither of the samples taken later showed a commercial shortage.

Essex Fertilizer Co., Boston, Mass.—XXX Fish and Potash, Nos. 282-844. Nitrogen found 1.91%, guaranteed 2%; available phosphoric acid found 7.63%, guaranteed 8%; potash found 3.08% guaranteed 3%.

National Fertilizer Co., Boston, Mass.—High Grade Top Dressing, No. 101. Nitrogen found 7.81%, guaranteed 8.43%; available phosphoric acid found 6.89%, guaranteed 6.25%; potash found 8.31%, guaranteed 8%.

New England Fertilizer Co., Boston, Mass.—Top Dressing Grass and Grain, No. 462. Nitrogen found 3.81%, guaranteed 4.11%; available phosphoric acid found 7.42%, guaranteed 7%; potash found 5.91%, guaranteed 6%.

Parmenter & Polsey Fertilizer Co., Boston, Mass.—A. A. Brand, No. 1038. Nitrogen found 4.01%, guaranteed 4.10%; available phosphoric acid found 6.82%, guaranteed 7%; potash found 7.73%, guaranteed 8%.

Swift's Lowell Fertilizer Co., Boston, Mass.—Special Grass Mixture, No. 145. Nitrogen found 3.84%, guaranteed 4.10%; available phosphoric acid found 7.22%, guaranteed 7%; potash found 5.89%, guaranteed 6%.

Wood Ashes.

Eleven samples of ashes have been analyzed and only one has shown a commercial deficiency: Geo. Stevens, Peterborough, Ontario, Canada, No. 297. Phosphoric acid found .64%, guaranteed 1.50%; potash found 1.81%, guaranteed 5%; calcium oxide found 24.3%, guaranteed 30%. Mr. Stevens states that the ashes

are shipped just as they are gathered from door to door; they are leached somewhat from exposure.

Ground Rock. The New England Mineral Fertilizer and Chemical Co. of Boston, Mass., has licensed and sold a product known as the "New Mineral Fertilizer." The material has the appearance of being finely ground rock or fine sand which has been fortified with small amounts of nitrate of soda so that the material will show a quick action when applied to vegetation. It might be said in this connection that the nitrate of soda is about the only available part of the material and furnishes a commercial value of $2.02 out of a total ton valuation of $2.30. The article was guaranteed .23% phosphoric acid, no water soluble potash, 1.56% total potash, and .45% nitrogen. It tested .24% total phosphoric acid, .18% water soluble potash, 1.04% acid soluble potash and .63% nitrogen. The advertised price was $17.00 per ton, making the actual cost of a pound of nitrogen, insoluble phosphoric acid and water soluble potash, $1.18, 15 cents and 37 cents respectively. The company make extravagant claims for the value of the silica, soda, lime, magnesia, iron, alumina, sulfur and chlorine which the material, like all ground rocks and soils, contains. It is needless to say, however, that these elements are found in most soils in sufficient quantity to meet the requirements of vegetation and if it became necessary to supply any of them, they could be had in much more soluble form and at a much less cost than by purchasing ground rock at $17.00 per ton.

Character of the Nitrogen Used.

For many years there has been a demand for some adequate and efficient method of differentiating between the active and inactive forms of organic nitrogen contained in mixed commercial fertilizers. Sixty or more per cent of the total nitrogen in the average mixed fertilizer is derived from organic sources, and until recently it has not been possible to tell the consumer much concerning its activity or immediate availability. Heretofore there has been published the nitrogen from nitrates and ammoniates as well as the water soluble and water insoluble organic nitrogen. It has seemed evident, however, that some of the brands contained at least a portion of their nitrogen in low grade forms, but a lack of a suitable method of analysis has rendered it impossible to procure sufficient evidence to definitely substantiate the supposition. In 1910, the chemists in charge of the fertilizer control work in New England, New York and New Jersey co-operated in an effort to make a careful study of the Jones' modification of the "Alkaline permanganate method" and Street's "Neutral permanganate method" for testing the activity of the water insoluble organic

nitrogen in mixed fertilizers. Satisfactory results were obtained with the Jones' modification, which were confirmed on the same samples by means of vegetation experiments conducted at the Rhode Island Experiment Station. The work proved so satisfactory that in March, 1911, the Jones' modification was adopted provisionally by the New England, New York and New Jersey Experiment Stations.

All of the complete fertilizers reported in this bulletin have, therefore, been tested as to their organic nitrogen activity. In the tables of analysis will be found columns headed "*Active Organic Nitrogen*" and "*Inactive Organic Nitrogen.*" This form of expression is somewhat abbreviated as compared with the form used by some of the other Experiment Stations. There are two reasons for this: 1st, lack of space due to publication of "Retail Cash Prices" and "Percentage of Difference," and 2d, the belief that the above form would be more clearly understood by the average consumer. By "*Active Organic Nitrogen*" is meant that portion which will probably be available during the first season of its application. The "*Inactive Organic Nitrogen,*" as its name indicates, will probably not be available as plant food the first season of its application, altho it may in time become active. There is not sufficient data at hand to give this form of nitrogen a definite value either agriculturally or commercially. In calculating the *commercial value* of the organic nitrogen in mixed fertilizers we have, therefore, as in past years assumed that it was derived wholly from high grade sources. This will give those fertilizers found containing low grade organic ammoniates a rather too high valuation.

Those brands having *less than* 50 *per cent* of their water insoluble organic nitrogen active or available have been designated in the tables by a cross placed within a circle ⊕ at the right above the figures in the column headed "*Inactive Organic Nitrogen.*" Wherever the circle is used it indicates that *low grade* nitrogen-containing organic matter has been used as a *part* of the total organic nitrogen in the fertilizer.

A good many brands have come near to the danger mark. The following have fallen below the 50 per cent standard, some more than others:

Armour Fertilizer Works, Baltimore, Md.

Fish and Potash,
Fruit and Root Crop Special,
Grain Grower.

Atlantic Fertilizer Co., Baltimore, Md.

Grain Fertilizer.

Baltimore Pulverizing Co., Baltimore, Md.

Quality Brand,
Market Garden.

Berkshire Fertilizer Co., Bridgeport, Conn.

Complete Fertilizer,
Ammoniated Bone Phosphate.

Buffalo Fertilizer Co., Buffalo, N. Y.

Celery and Potato Special,
High Grade Manure,
New England Special.

E. D. Chittenden Co., Bridgeport, Conn.

Grass and Grain,
Grain and Vegetables,
Potato and Grain.

Coe-Mortimer Co., New York City.

New Englander Corn and Grain,
Complete Manure with 10% Potash,
Special Grass Top Dressing,
Red Brand Excelsior Guano,
Excelsior Potato,
Standard Potato Fertilizer,
XXV Ammoniated Bone Superphosphate.

Mapes' Formula and Peruvian Guano Co., New York City.

Vegetable Manure,
Cauliflower and Cabbage,
Complete Manure for Heavy Soils,
Complete Manure, 10% Potash,
Average Soil Complete Manure,
Top Dresser Improved Half Strength,
Tobacco Ash Constituents,
Lawn Top Dressing,
Corn Manure,
General Use,
Cereal Brand,
Grass and Grain Spring Top Dressing,
Complete Manure, A Brand,
Tobacco Starter,
Potato Manure,
Fruit and Vine,
Economical Potato Manure,
Grain Manure,

Olds & Whipple, Hartford, Conn.

Fish and Potash.

Ross Bros. Co., Worcester, Mass.

Lawn and Garden Fertilizer.

Swift's Lowell Fertilizer Co., Boston, Mass.

Lawn Dressing,
Sterling Phosphate.

The following facts were brought out through correspondence with the above companies:

The Armour Fertilizer Works contend that all of their materials are purchased on a certain percentage guarantee of available nitrogen. Further, that "while the availability of such materials as acidulated garbage tankage may give low results by the alkaline permanganate method, yet no one with a practical knowledge of the fertilizer business will seriously contend that acidulated garbage tankage should be excluded from commercial fertilizers. The demand for ammoniates is too heavy to permit of such a ruling." A later communication states that, so far as they are able to tell, the ammonia in their goods was derived from nitrate of soda, fish tankage, packing-house tankage and acidulated base goods.

The Atlantic Fertilizer Company state that the management has undergone an entire change since the shipping season last spring and they have had difficulty in getting any definite information regarding operations early in the season. They admit that some low grade organic ammoniates were used. The company state that they now have a chemist who will test all materials received and goods shipped and that whatever goods are shipped into Massachusetts during the coming season will meet the requirements.

The Baltimore Pulverizing Company state that most of their nitrogen is supplied by sulfate of ammonia, a small amount by

nitrate of soda and a small amount by bone tankage. It is true that only small amounts of water insoluble nitrogen were found present in the two brands, most of the nitrogen being in the form of ammoniates and nitrates; yet the low activity shown on the water insoluble portion indicates that its source was other than bone tankage.

The Berkshire Fertilizer Company claim that in case of their Complete Fertilizer sufficient animal tankage, nitrate of soda and sulfate of ammonia were used to meet the minimum guarantee (2.5%). They state that 100 pounds of beet root manure and a little over 100 pounds of grape pomace were added as a filler which was not counted in the guarantee. In case of the Ammoniated Bone Phosphate, the claim is made that sufficient high grade tankage was used to furnish the nitrogen up to the guarantee. Ground grape pomace and garbage tankage were used in place of filler containing no fertilizing value. This explanation is reasonable as in both cases the fertilizers showed an overrun of nitrogen, the complete fertilizer .2% and the ammoniated bone phosphate .64%.

The Buffalo Fertilizer Company state that some garbage tankage was used in the low grade brands, but more as a filler and to put the goods in perfect mechanical condition than as a source of ammonia. They depended upon this source for the excess over the minimum guarantee. They state further that another spring no garbage tankage at all will be used except as a filler or drier. It might be added in this connection that the brands in question ran only from .1 to .2% over the lower guarantee.

The E. D. Chittenden Company state that the base mixture from which their goods were made tested 84% availability prior to the manufacturing of the goods. They also state that a further investigation will be made and a later report furnished, but no further explanation has come to hand.

The Coe-Mortimer Company claim that early in the season they used considerable low grade calcium cyanamid, which contains quite a proportion of peat, added for the purpose of allaying dust and producing a good mechanical condition. The claim made by the producers of the cyanamid product was that the nitrogen in the peat was rendered available during the process of manufacture. As soon as it was discovered that the nitrogen in the peat was not available, the use of the cyanamid product was discontinued. It is their belief that the goods taken by our inspectors were from shipments where this cyanamid product had been used.

Mapes' Formula and Peruvian Guano Company have the following to say: "We furnish almost all of the nitrogen in the form of soluble nitrate and ammonia salts. The organic nitrogen is very low, coming from the special grades of degelatinized bone meal and

Peruvian guano low in nitrogen, which we use as a source of our phosphoric acid. For mechanical reasons, in different brands at times, for the sake of getting proper bulk and to prevent caking, we do use small proportions of tartar pomace and even special grades of garbage tankage. We have always believed that the addition of the small quantity of inactive organic ammoniate which we have used, where the solubility of the total nitrogen in our brands runs so very high, was not at all a disadvantage; certainly not enough to counteract the very positive advantage in keeping the goods in first-class drilling condition. It is very difficult with fertilizers such as ours, containing so high a percentage of soluble salts, to avoid some caking under different conditions of moisture, and these organic ammoniates are very valuable in preventing such caking." It may be said in this connection that the greater part of the nitrogen in this company's goods is actually present as nitrates and ammoniates, and in the majority of cases the total nitrogen shows a considerable margin or overrun. There are, however, six cases out of the eighteen which do not show a sufficient excess of nitrogen over the minimum guarantee to warrant the statement that the low grade ammoniate was used solely as a conditioner. In other words, the sum of nitrogen contained in the low grade ammoniate and the nitrogen found in the more available forms, barely equals the minimum guarantee. This, of course, may be accidental. It is believed that the manufacturers are sincere in their statement.

Olds & Whipple say: "We cannot understand why the activity of the organic nitrogen (in the fish and potash) is not a higher percentage than reported. We however this coming season will see if it is not possible to change the material to make the percentage of active nitrogen run somewhat higher and yet not injure the fertilizer as to its results on the crops."

Ross Bros. Company state that in the Lawn and Garden brand the organic nitrogen was derived wholly from bone, sheep manure and tobacco dust. That the Potato and Vegetable brand was manufactured for them by another company outside of the state. It is quite probable that the nitrogen from pulverized sheep manure and tobacco dust would not show as active as from the high grade animal ammoniates, and quite likely their use accounts for the low activity shown.

Swift's Lowell Fertilizer Company state that no organic matter was used in the Lawn Dressing brand this past season; that it was made entirely from chemicals using either nitrate of soda or sulfate of ammonia for the nitrogen content. The case is not a serious one as the greater part of the nitrogen present was from nitrates and ammoniates.

So far as one is able to judge from the analytical data and the explanations furnished the following facts may be deduced:

1. Some manufacturers used nitrogen-containing material of a low availability.

2. In some cases it was used as a direct source of nitrogen to bring the fertilizer up to its minimum guarantee. In other cases it was used to raise the guarantee above the minimum. In still other cases it was employed as a filler or to improve the mechanical condition of the fertilizer.

3. It is possible that the inactive materials employed were not sufficiently treated to render their nitrogen available.

It is hoped that manufacturers will endeavor to improve conditions another season for it is believed that the consumer of commercial fertilizers—at least of the better grades—is entitled to receive all of his nitrogen in such an available form as is called for by the 50 percent alkaline permanganate standard.

Character of the Phosphoric Acid Used.

Many of the fertilizer mixtures contained large overruns in total phosphoric acid while the available phosphoric acid on the same brands has shown a considerable shortage. This may have been due to incomplete acidulation of the bone or raw mineral phosphate used or to the addition of considerable unacidulated rock phosphate, bone, or roasted iron or alumina phosphate. Of the total phosphoric acid found in all of the brands analyzed, 84 percent was present in available forms. In case of the available phosphoric acid found, 58 percent was present in water soluble form.

Character of the Potash Used.

As in previous years, the form in which the potash was present has been noted in every fertilizer analyzed. Footnotes in the tables of analysis will indicate when the potash is in form of sulfate or carbonate. The absence of the asterisk (*) or dagger (†) following the potash percentage is an indication that it was present as chloride. Very few cases have been found showing the absence of chlorides in those brands where sulfate is guaranteed. In the majority of cases, however, the amount of chlorine found present has been so small as to be counted as incidental. A quantitative test, however, has in all cases been made and will be found in the footnote. In case of some of the tobacco brands, quite a considerable quantity of chlorine has been found where carbonate of potash was guaranteed. This would indicate the use of carbonate of potash from the beet sugar industry. The latter material frequently contains as high as 10 to 12% muriate of potash.

In one case where the potash was guaranteed present as carbonate, enough soluble sulfates were found present to unite with all of the potash present. The brand was the "Berkshire Tobacco Special with Carbonate of Potash," represented by Nos. 50-77-174-337-550. The Berkshire Fertilizer Company claimed that every pound of potash in the brand was derived from high grade carbonate, but that some sulfate of ammonia was used in the goods as a nitrogen source. This, of course, would account for the soluble sulfates present and the case serves to show the inconsistency of furnishing potash from carbonate and using another chemical that will furnish an amount of soluble sulfates equivalent to the potash present. It is reasonable to suppose that if the consumer pays for carbonate of potash he expects that the fertilizer will exclude both soluble chlorides and sulfates.

Explanation of Tables and Analyses.

In the first column will be found the name and address of the fertilizer manufacturer and the names of the brands analyzed.

The second column designates the town where each sample was drawn. Where the words "manufacturer's sample" occur, a certified sample was sent on by the manufacturer at our request.

The column giving "dealer's cash price per ton" shows the cash price that was charged the consumer for one ton of fertilizer at the place where the brand was collected. There are in some instances very wide differences between the prices which were charged by various agents for the same brand. These variations have, however, been verified by the agents in writing and so are published for what they are worth.

The "valuation" column shows the retail cash cost in our large markets or centers of distribution of amounts of nitrogen, phosphoric acid and potash, equivalent to those found in one ton of the fertilizer.

The "percentage of difference" column shows the percentage excess of the retail cash price over the valuation another manner of expressing the difference between the cash cost and the commercial valuation of the fertilizer.

The "laboratory number" is simply a reference number used in the collection and analyses of the various brands.

In the nitrogen column "as nitrates and ammoniates" signifies that by actual test the amounts designated were found present either as nitrates of soda, potash or lime and as sulfate of ammonia. Both forms being readily soluble in water and highly available and valued at the same figure, it was not thought necessary to separate the two inasmuch as they are determined jointly by the same method. The term "active organic" nitrogen designates that portion

supposed to be readily available to growing plants. The term "inactive organic" nitrogen designates that portion of the total organic nitrogen which would be less available to growing plants than that which is indicated as active.

In the phosphoric acid column the insoluble phosphoric acid is that part of the total phosphoric acid insoluble in water or a neutral solution of citrate of ammonia. The reverted phosphoric acid is that portion dissolved by a neutral solution of citrate of ammonia (specific gravity 1.09) by treating two grams of the fertilizer, previously washed with water, with 100 c. c. of the citrate solution one-half hour at 65°C. It is supposed to represent that part of the phosphoric acid insoluble in water but soluble in soil and root acids —it represents the difference between the total and the sum of the soluble and insoluble phosphoric acids. The available phosphoric acid column represents the sum of the soluble and reverted phosphoric acid.

The potash column shows the percent of potash soluble in water; results published without an asterisk (*) or dagger (†) indicate that the potash is present as chloride or that sufficient chlorine is present in the fertilizer to unite with all of the potash. Footnotes indicate the amount of potash present as sulfate and carbonate.

The guarantee columns show the minimum percentage of nitrogen, total and available phosphoric acid, and potash guaranteed by the manufacturer to be present.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
W. H. Abbott, Holyoke, Mass.				
Abbott's Tobacco Fertilizer	No. Hadley	$41.00	$30.19	35.81
" " "	Sunderland	41.00	31.41	30.53
Abbott's Onion Fertilizer	Sunderland	38.00	28.11	35.18
American Agric. Chem. Co., 92 State St., Boston.				
Tobacco Starter and Grower	Sunderland	37.00	24.03	53.98
" " " "	Holden	37.00	22.96	61.15
" " " "	Westfield	36.10	23.69	52.38
High Grade Fertilizer with 10% Potash	Bellerica	40.00	23.29	71.75
High Grade Fertilizer with 10% Potash	Worcester	40.00	23.90	62.14
" " " " " "	W. Springfield	37.50		
Grass and Lawn Top Dressing	Millis	36.00	22.69	58.66
Grass and Lawn Top Dressing	Milford	33.00	20.02	84.32
" " " " "	Holyoke	36.00		
Special Grass and Garden Mixture	Bradstreet	55.00	42.79	28.53
" " " " "	Concord	52.00	42.78	21.55
Church's Fish and Potash	Sunderland	30.00	15.96	81.70
" " " "	New Bedford	28.00		
Church's Fish and Potash	W. Springfield	27.00	17.54	53.94
North Western Empire Special	Fall River	35.50	25.77	34.85
" " " "	Seekonk	34.00		
Baker's A. A. Brand, East India	New Bedford	35.00	20.63	69.65
Bradley's X L Superphosphate of Lime	Sunderland	32.00	20.17	63.61
" " " " "	New Bedford	33.00		
" " " " "	Middleboro	34.00		
Bradley's X L Superphosphate of Lime	Marblehead	32.00	20.34	57.33
Bradley's Potato Manure	New Bedford	33.00	20.90	70.32
" " "	Millis	32.00		
" " "	Middleboro	42.10		
Bradley's Corn Phosphate	Millis	29.00	17.77	70.68
" " "	Chelmsford	30.00		
" " "	Boston	32.00		
Bradley's Corn Phosphate	Milford	35.00	17.76	97.08
Bradley's Eclipse Phosphate	Millis	27.00	13.92	93.96
Bradley's Eclipse Phosphate	Amesbury	27.00	14.34	91.78
" " "	Bedford	28.00		
Bradley's Potato Fertilizer	Millis	30.00	18.22	70.14
" " "	Brockton	32.00		
Bradley's Potato Fertilizer	Chelmsford	30.00	18.72	60.26
" " "	Marblehead	30.00		
Bradley's Comp. Man. for Potatoes and Vegetables	Bradstreet	40.00	26.89	48.76
" " " " " " "	Sunderland	40.00	26.35	51.80
" " " " " " "	Millis	38.00	26.24	44.82
Bradley's Comp. Man. Top Dress. Grass and Grain	Bradstreet	40.00	25.14	59.11
" " " " " " " "	Sunderland	40.00	23.24	72.12
" " " " " " " "	Holyoke	37.00	23.68	56.25
Bradley's Comp. Man. with 10% Potash	Bradstreet	41.00	27.60	48.55
" " " " " "	Beverly	—	27.21	—
" " " " " "	Holyoke	38.00	26.97	40.90
Bradley's Comp. Man. for Corn and Grain	West Upton	40.00	26.22	52.55

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Nitrogen: Active Organic.	Nitrogen: Inactive Organic.	Nitrogen Total: Found.	Nitrogen Total: Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid Total: Found.	Phosphoric Acid Total: Guaranteed.	Phosphoric Acid Available: Found.	Phosphoric Acid Available: Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash: Guaranteed
175	10.77	1.08	2.03	.86	3.97	4.00	.26	7.14	5.61	13.01	10.00	7.40	7.00	7.04*	10.00
196	11.05	1.24	1.83	.72	3.97	4.00	.23	6.87	4.64	11.74	10.00	7.10	7.00	9.67**	10.00
201	10.36	.75	1.78	.73	3.26	3.50	trace	6.20	5.92	12.12	10.00	6.20	8.00	8.41*	7.00
75	11.29	1.73	1.16	.40	3.29	3.29	7.02	2.22	.99	10.23	9.00	9.24	8.00	3.91*	4.00
817	10.90	1.16	1.49	.42	3.07	3.29	5.61	2.20	1.63	9.44	9.00	7.81	8.00	4.88	4.00
947	8.39	1.42	1.35	.40	3.17	3.29	3.86	4.73	2.58	11.17	9.00	8.59	8.00	3.93*	4.00
593	10.74	.37	1.47	.48	2.32	2.47	3.13	2.63	1.79	7.55	7.00	5.76	6.00	10.20	10.00
383, 931	9.54	.91	1.05	.38	2.34	2.47	3.76	2.42	2.42	8.60	7.00	6.18	6.00	10.57	10.00
405	3.54	1.67	1.94	.56	4.17	3.91	3.67	2.07	.41	6.15	6.00	5.74	5.00	2.62	2.00
691, 926	7.46	1.78	1.52	.41	3.71	3.91	2.78	2.47	.97	6.22	6.00	5.25	5.00	2.04	2.00
36	6.87	3.50	3.37	1.37	8.24	8.43	1.31	4.58	1.33	7.22	7.25	5.89	6.25	8.54	8.25
477	6.06	2.51	4.66	1.31	8.48	8.43	.98	3.72	.84	5.54	7.25	4.70	6.25	7.85	8.25
157, 298	10.01	.41	1.31	.38	2.10	2.06	3.04	3.34	1.43	7.81	7.00	6.38	6.00	2.25	2.00
939	10.68	.68	1.25	.32	2.25	2.06	5.33	2.09	.92	8.34	7.00	7.42	6.00	2.64	2.00
241, 311	10.67	1.42	1.58	.42	3.42	3.29	4.57	2.60	2.19	9.36	9.00	7.17	7.00	7.25	7.00
268	13.60	.70	1.50	.41	2.61	2.47	6.54	2.44	2.09	11.07	10.00	8.98	9.00	2.43	2.00
165, 275, 401	14.19	.84	1.26	.45	2.55	2.47	6.16	2.56	2.40	11.12	10.00	8.72	9.00	2.46	2.00
624	13.46	.64	1.40	.46	2.50	2.47	6.03	3.94	1.56	11.53	10.00	9.97	9.00	1.94	2.00
292, 386, 395	9.92	.73	1.44	.45	2.62	2.47	4.40	2.33	1.43	8.16	7.00	6.73	6.00	5.42	5.00
383, 556, 566	12.40	.78	.97	.47	2.22	2.06	5.46	2.94	1.91	10.31	9.00	8.40	8.00	1.75	1.50
765	12.40	.51	1.36	.36	2.23	2.06	5.17	3.36	1.73	10.26	9.00	8.53	8.00	1.43	1.50
353	11.54	.30	.59	.28	1.17	1.03	5.49	2.70	1.25	9.44	9.00	8.19	8.00	2.21	2.00
606, 780	10.26	.13	.85	.18	1.16	1.03	5.68	2.36	2.45	10.49	9.00	8.04	8.00	2.14	2.00
399, 438	11.94	.94	.79	.39	2.12	2.06	5.78	2.44	1.53	9.75	9.00	8.22	8.00	3.21	3.00
615, 626	12.99	.53	1.10	.46	2.09	2.06	5.78	2.59	2.04	10.41	9.00	8.37	8.00	3.16	3.00
43	11.21	1.26	1.60	.61	3.47	3.29	6.29	1.95	1.38	9.62	9.00	8.24	8.00	7.35	7.00
114	11.13	2.45	.67	.32	3.44	3.29	5.55	3.18	1.91	10.64	9.00	8.73	8.00	7.35	7.00
402	11.60	.95	1.77	.51	3.23	3.29	4.82	3.32	2.37	10.51	9.00	8.14	8.00	7.21	7.00
39	7.78	3.14	1.41	.42	4.97	4.94	5.01	.60	.64	6.25	6.00	5.61	5.00	2.96	2.50
110	7.63	4.42	.26	.13	4.81	4.94	2.10	3.64	.64	6.38	6.00	5.74	5.00	2.92	2.50
927	9.90	3.46	1.01	.32	4.79	4.94	2.91	2.60	.61	6.12	6.00	5.51	5.00	2.77	2.50
41	10.97	1.23	1.48	.58	3.29	3.29	3.13	3.76	1.17	8.06	7.00	6.89	6.00	10.73	10.00
393	11.83	.99	1.73	.59	3.31	3.29	3.89	2.49	1.58	7.96	7.00	6.38	6.00	10.16	10.00
936	8.54	1.37	1.45	.44	3.26	3.29	4.59	2.12	1.56	8.27	7.00	6.71	6.00	10.09	10.00
751	10.55	1.39	1.51	.46	3.36	3.29	8.36	3.33	1.12	12.81	13.00	11.69	12.00	3.83	3.00

*No. 175 Chlorine .27%, equivalent to .35% potash, 6.69% potash as sulfate.
** " 196 Potash as sulfate.
* " 201 Chlorine .36%, equivalent to .48% potash, 7.93% potash as sulfate.
" 75 " .82% " " 1.09% " 2.20% " " "
" 947 " .77% " " 1.00% " 2.93% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co. (Continued).				
Bradley's Comp. Man. for Corn and Grain	Holyoke	$37.00	$25.98	42.42
Bradley's Seeding Down Manure	Sterling	32.00	20.02	59.84
Bradley's Niagara Phosphate	Plymouth	28.00	12.26	128.40
" " "	Westfield	25.65	12.25	109.40
Bradley's English Lawn Fertilizer	Middleboro	48.00	25.12	79.14
" " " "	Brockton	42.00		
Bradley's English Lawn Fertilizer	Amesbury	55.00	23.69	132.15
Bradley's Columbia Fish and Potash	Westfield	27.55	13.87	98.63
Bradley's H. G. Fertilizer with 10% Potash	Amesbury	36.00	24.63	46.16
Clark's Cove Bay State Fertilizer	Man'f't'r's sample	32.00	20.66	54.89
Clark's Cove Bay State Fertilizer G. G.	Concord	28.00	17.72	58.02
Clark's Cove Potato Manure	Man'f't'r's sample	32.00	20.23	58.18
" " " Fertilizer	Concord	30.00	18.89	58.81
" " " "	Spencer	32.00	18.19	75.92
Clark's Cove Great Planet Manure	Spencer	40.00	26.07	53.44
Crocker's Ammoniated Corn Phosphate	Worcester	32.00	17.11	87.03
Crocker's Potato, Hop and Tobacco Phosphate	Worcester	32.00	19.44	64.50
Cumberland Superphosphate	N. Leominster	32.00	16.18	90.38
Cumberland Potato Fertilizer	N. Leominster	32.00	18.10	76.80
Darling's Potato Manure	Sunderland	32.00	21.21	50.88
" " "	N. Amherst	30.00	20.12	49.11
Darling's Farm Favorite	Worcester	32.00	17.78	79.98
Darling's Complete 10% Manure	Barre Plains	38.00	26.56	43.07
Darling's General Fertilizer	E. Pepperell	32.00	16.61	92.65
Darling's Blood, Bone and Potash	E. Pepperell	40.00	26.49	51.00
" " " " "	Worcester	40.00		
Darling's Potato and Root Crop Manure	Worcester	39.00	25.83	50.99
Farquhar's Lawn and Garden Dressing	Boston	50.00	28.07	78.13
Farquhar's Potato and Vegetable Fertilizer	Boston	45.00	24.39	84.50
Great Eastern Northern Corn Special "A"	Pratt's J'ct'n	31.00	21.05	42.52
" " " " " "	So. Athol	29.00		
Great Eastern Northern Corn Special	Agawam	32.00	20.51	56.02
Great Eastern Vegetable Vine and Tobacco	Chelmsford	32.00	20.45	54.04
" " " " " "	Pratt's Jct'n	31.00		
Great Eastern Garden Special	E. Longmeadow	39.00	25.89	50.64
Great Eastern General Fertilizer	Concord	30.00	14.90	81.21
" " " "	Upton	—		
" " " "	Concord	27.00		
" " " "	Agawam	24.00		
Pacific Potato Special	Newburyport	32.00	17.63	81.51
Pacific High Grade General	Wayland	40.00	25.72	55.52
Soluble Pacific Guano	Newburyport	30.00	16.75	79.10
Packers' Union Animal Corn Fertilizer	Amherst	35.00	19.63	78.30
" " " " "	Upton	—		
Packers' Union Potato Manure	Amherst	35.00	21.39	59.89
" " " "	Upton	—		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total. Found.	Total. Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
930	12.07	2.22	.88	.32	3.42	3.29	8.80	3.44	1.56	13.80	13.00	12.24	12.00	3.28	3.00
824	15.29	.50	1.25	.61	2.34	2.47	7.59	2.16	1.96	11.71	10.00	9.75	9.00	2.02	2.00
610	10.63	.34	.50	.24	1.08	.82	5.36	2.04	1.35	8.75	8.00	7.40	7.00	1.44	1.00
934	9.57	.63	.28	.18	1.09	.82	4.76	2.30	1.48	8.54	8.00	7.06	7.00	1.98	1.00
409 } 436 }	8.69	2.57	1.90	.52	4.99	4.94	3.57	1.53	.79	5.89	6.00	6.10	5.00	2.90	2.50
605	8.94	3.39	.97	.44	4.80	4.94	1.31	4.18	.56	6.05	6.00	5.49	5.00	2.89	2.50
924	7.94	.19	1.09	.41	1.69	1.65	2.81	1.94	2.50	7.25	6.00	4.75	5.00	2.57	2.00
600	11.20	.88	1.14	.42	2.44	2.47	4.31	1.92	2.14	8.37	7.00	6.23	6.00	10.93	10.00
1056	13.40	.59	1.72	.52	2.83	2.47	5.04	3.69	2.04	10.77	10.00	8.73	9.00	1.76	2.00
525	12.11	.81	.90	.50	2.21	2.06	6.12	2.17	1.79	10.08	9.00	8.29	8.00	1.85	1.50
1053	10.99	.53	1.40	.61	2.54	2.47	3.70	2.71	1.45	7.86	7.00	6.41	6.00	5.19	5.00
429	11.29	.50	1.21	.51	2.22	2.06	5.84	2.22	1.53	9.59	9.00	8.06	8.00	3.25	3.00
909	12.54	.98	.71	.37	2.06	2.06	5.65	2.95	1.45	10.05	9.00	8.60	8.00	3.18	3.00
910	11.52	1.07	1.59	.48	3.14	3.29	6.06	2.38	1.94	10.38	9.00	8.44	8.00	7.34	7.00
885	11.84	.81	.93	.37	2.11	2.06	6.93	2.25	2.02	10.20	9.00	8.18	8.00	1.61	1.50
884	12.39	.85	1.00	.40	2.25	2.06	6.76	1.48	2.35	10.59	9.00	8.24	8.00	3.44	3.00
639	11.29	.68	1.01	.42	2.11	2.06	5.33	2.33	2.14	9.80	9.00	7.66	8.00	1.63	1.50
640	13.22	.93	.79	.34	2.06	2.06	5.97	1.89	2.14	10.00	9.00	7.86	8.00	3.37	3.00
116	10.63	1.31	.92	.33	2.56	4.47	4.97	1.99	1.61	8.57	7.00	6.96	6.00	6.26	5.00
651	12.30	1.33	.82	.36	2.51	2.47	4.89	2.53	2.04	9.46	7.00	7.42	6.00	4.59	5.00
819	11.70	.65	1.07	.36	2.08	2.06	5.20	2.25	2.32	9.77	9.00	7.45	8.00	3.02	3.00
842	9.97	1.08	1.55	.56	3.19	3.29	4.46	1.97	1.68	8.11	7.00	6.43	6.00	9.88	10.00
686	12.14	.24	.96	.44	1.64	1.23	5.97	1.76	1.73	9.46	7.00	7.73	6.00	3.26	3.00
685 } 809 }	11.42	.98	2.02	.59	3.59	4.11	5.04	2.06	2.14	9.24	8.00	7.10	7.00	6.89	7.00
816	10.89	1.38	1.28	.51	3.17	3.29	6.06	1.80	1.94	9.80	9.00	7.86	8.00	7.36*	7.00
538	4.63	.71	2.16	.71	3.57	3.30	trace	6.88	6.05	12.93	14.00	6.88	4.00	7.58	7.00
566	10.65	1.42	1.18	.41	3.01	3.00	4.76	2.38	2.27	9.41	7.00	7.14	—	7.53	7.00
874 } 901 }	12.06	.88	1.14	.39	2.41	2.47	6.67	1.52	1.89	10.08	10.00	8.19	9.00	4.86	2.00
970	12.08	.76	1.34	.49	2.59	2.47	7.14	1.96	1.84	10.94	10.00	9.10	9.00	2.38	2.00
536 } 872 }	12.05	.75	1.06	.41	2.22	2.06	6.57	1.64	1.99	10.20	9.00	8.21	8.00	4.88	6.00
1034	12.24	.90	1.58	.64	3.12	3.29	6.29	2.13	1.68	10.10	9.00	8.42	8.00	7.18	7.00
389 } 740 } 806 } 977 }	11.60	.20	.41	.33	.94	.82	6.10	1.92	1.96	9.98	9.00	8.02	8.00	4.10	4.00
589	11.45	.75	.87	.41	2.03	2.06	5.55	2.38	1.25	9.18	9.00	7.93	8.00	3.19	3.00
1045	11.49	1.49	1.30	.45	3.24	3.29	6.22	2.73	.74	9.69	9.00	8.95	8.00	6.90	7.00
594	11.74	.71	.92	.40	2.03	2.06	5.61	2.40	1.76	9.77	9.00	8.01	8.00	1.80	1.50
687 } 766 }	14.29	.74	1.13	.56	2.43	2.47	6.35	2.53	1.84	10.72	10.00	8.88	9.00	2.38	2.00
698 } 753 }	13.17	.56	1.20	.43	2.19	2.06	5.91	2.23	1.71	9.85	9.00	8.14	8.00	6.82	6.00

*No. 816 Chlorine 3.93% Equivalent to 5.22% potash, 2.14 potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chemical Co. (Continued.)				
Packer's Union Gardeners' Complete Manure	Concord	$38.00	$25.72	49.69
" " " " "	Amherst	39.00		
Quinnipiac Phosphate	Man'f't'r's sample	32.00	20.71	54.51
Quinnipiac Potato Manure	Seekonk	—	19.00	73.68
" " "	N. Amherst	33.00		
Quinnipiac Market Garden Manure	Fall River	37.00	25.19	48.19
" " " "	Seekonk	—		
" " " "	N. Amherst	38.00		
" " " "	Holyoke	37.00		
Quinnipiac Corn Manure	N. Amherst	30.00	17.00	76.48
Quinnipiac Potato Phosphate	Fall River	30.00	18.50	62.16
" " "	Holyoke	30.00		
Read's Farmers' Friend Superphosphate	Billerica	32.00	17.55	82.34
Read's Practical Potato Special	Billerica	32.00	14.14	126.32
" " " "	Sheffield	30.00	14.49	107.05
Read's Standard Superphosphate	Man'f't'r's sample	—	13.72	—
Read's Vegetable and Vine Fertilizer	So. Barre	32.00	21.21	55.58
" " " " "	Marlboro	34.00		
Read's H. G. Farmers' Friend Superphosphate	So. Barre	40.00	26.36	51.74
" " " " " "	Marlboro	40.00		
Standard Fertilizer	Whitman	32.00	17.11	87.02
" "	Upton	32.00		
Standard Guano for all Crops	Upton	32.00	13.61	124.55
" " " " "	Clifton	29.00		
Standard Complete Manure	Munson	40.00	26.25	52.38
Standard Special for Potatoes	Whitman	32.00	18.14	80.10
" " " "	Upton	33.00		
" " " "	Clinton	33.00		
Wheeler's Corn Fertilizer	Chelmsford	30.00	16.02	93.51
" " "	Littleton	32.00		
Wheeler's Potato Manure	Concord	32.00	18.54	68.29
" " "	Danvers	29.60		
" " "	Agawam	32.00		
Wheeler's Havana Tobacco Grower	Danvers	36.00	26.06	39.41
" " " "	Littleton	38.00		
" " " "	Agawam	35.00		
Williams & Clark's Amer. Ammo. Bone Superphos.	Southboro	31.00	19.75	56.96
Williams & Clark's H. G. Special for Potatoes & Veg's.	W.B'water	38.00	26.33	42.42
" " " " " " " " " "	Southboro	37.00		
Williams & Clark's Americus Potato Manure	Brockton	36.00	13.09	76.90
" " " " " "	Southboro	28.00		
Williams & Clark's Americus Corn Phosphate	Sheffield	30.00	16.53	81.49
Williams & Clark's Potato Phosphate	Man'f't'r's sample	32.00	19.60	63.26
Williams & Clark's Royal Bone Phosphate	Brockton	32.00	13.60	113.25
" " " " " "	Newburyport	26.00		
Williams & Clark's Prolific Crop Producer	Brockton	28.00	12.88	117.40
" " " " " "	Worcester	28.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs Found.	Guaranteed.
802, 848	7.45	1.34	.92	.37	2.63	2.47	4.46	1.79	1.66	7.91	7.00	6.25	6.00	10.26*	10.00
1058	13.46	.53	1.70	.57	2.80	2.47	5.10	3.93	1.89	10.92	10.00	9.03	9.00	1.69	2.00
246, 548	11.40	1.17	.93	.29	2.39	2.47	3.89	2.51	2.07	8.47	7.00	6.40	6.00	4.75	5.00
301, 312, 592, 948	11.74	1.28	1.36	.50	3.14	3.29	5.29	2.31	2.50	10.10	9.00	7.60	8.00	7.10	7.00
565	13.07	.78	.98	.41	2.17	2.06	5.49	2.30	2.19	9.98	9.00	7.79	8.00	1.50	1.50
229, 929	13.16	.91	.97	.38	2.26	2.06	5.78	2.02	1.61	9.41	9.00	7.80	8.00	3.21	3.00
617	12.56	1.10	.69	.34	2.13	2.06	4.82	2.89	1.86	9.57	9.00	7.71	8.00	2.97	3.00
618	7.97	.16	.48	.34	.98	.82	2.27	2.07	1.35	5.69	5.00	4.34	4.00	7.19	8.00
1014	7.12	.24	.55	.30	1.09	.82	2.14	1.99	1.28	5.41	5.00	4.13	4.00	7.40	8.00
1054	10.16	.34	.31	.22	.87	.82	4.97	3.10	1.04	9.11	9.00	8.07	8.00	3.69	4.00
833, 867	12.20	.49	1.17	.48	2.14	2.06	6.10	1.88	2.02	10.00	9.00	7.98	8.00	6.17	6.00
840, 873	10.43	1.82	1.08	.34	3.24	3.29	5.01	1.50	1.63	8.14	7.00	6.51	6.00	10.00	10.00
471, 756	11.44	.82	.95	.36	2.13	2.06	5.80	2.11	1.99	9.90	9.00	7.91	8.00	1.81	1.50
769, 876	12.60	.29	.53	.27	1.09	1.03	4.06	4.07	1.56	9.69	9.00	8.13	8.00	2.29	2.00
1036	12.77	1.19	1.71	.56	3.46	3.29	5.40	2.41	2.22	10.03	9.00	7.81	8.00	6.63	7.00
475, 704, 677	11.81	.77	.86	.43	2.06	2.06	5.74	2.27	1.94	9.95	9.00	8.01	8.00	3.23	3.00
569, 658	11.89	.34	.89	.43	1.66	1.65	5.74	2.25	1.99	9.98	9.00	7.99	8.00	2.21	2.00
370, 514, 966	12.76	1.09	.78	.25	2.12	2.06	5.17	3.53	.99	9.69	9.00	8.70	8.00	3.60	3.00
523, 679, 968	6.83	1.32	.87	.36	2.55	2.47	4.06	2.11	1.56	7.73	7.00	6.17	6.00	11.02*	10.00
694	12.46	1.26	.86	.36	2.48	2.47	7.25	1.89	2.65	11.79	10.00	9.14	9.00	2.05	2.00
449, 712	11.60	1.51	1.34	.45	3.30	3.29	5.97	1.99	2.47	10.43	9.00	7.96	8.00	7.52	7.00
469, 683	12.44	.86	.77	.46	2.09	2.06	5.71	2.20	1.66	9.57	9.00	7.91	8.00	3.37	3.00
1008	10.59	.91	.88	.33	2.12	2.06	5.29	2.37	1.91	9.57	9.00	7.66	8.00	1.60	1.50
1055	10.88	.70	1.23	.51	2.44	2.47	3.34	3.20	1.30	7.84	7.00	6.54	6.00	5.07	5.00
447, 590	11.64	.27	.57	.28	1.12	1.03	4.95	3.06	1.20	9.21	9.00	8.01	8.00	2.29	2.00
435, 882	11.49	.42	.48	.22	1.12	.82	5.33	2.51	1.40	9.24	8.00	7.84	7.00	1.61	1.00

*No. 802–848 Chlorine .43%, equivalent to .58% potash, 9.68% potash as sulfate.
" 523–679–968 " .30% " " .39% " 10.63% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works, Baltimore, Md.				
Armour's Grain Grower	Salem	$26.00		
" " "	Newburyport	30.00		
" " "	Plymouth	26.00		
" " "	Marblehead	26.00	$16.54	59.19
" " "	W. Springfield	25.00		
" " "	W. Springfield	27.00		
Armour's All Soluble	Amherst	33.00	21.92	52.83
" " "	Taunton	34.00		
American Farmers' Market Garden Special	Fall River	32.00	26.30	17.87
" " " " "	Woburn	30.00		
Armour's Complete Potato	Fall River	26.00	20.43	48.93
" " "	Woburn	35.00		
Armour's Fish and Potash	Taunton	25.00		
" " " "	Woburn	28.00	17.25	60.41
" " " "	Marblehead	30.00		
Armour's Ammoniated Bone with Potash	Fall River	25.00		
" " " " "	Salem	29.00	18.00	53.71
" " " " "	Easthampton	29.00		
Armour's High Grade Potato Fertilizer	Amherst	33.00	24.35	37.58
" " " " "	Taunton	34.00		
Armour's Blood Bone and Potash	Amherst	38.00		
" " " " "	N. Hadley	—	29.78	27.60
Armour's Blood Bone and Potash	Leominster	37.00	30.20	22.52
Armour's Fruit and Root Crop Special	Billerica	29.00	19.09	57.15
" " " " " "	Newburyport	31.00		
Armour's Onion Special	No. Hadley	—	28.72	—
" " "	Marblehead	33.00	30.00	10.00
R. T. Prentiss' Top Dressing	W. Springfield	40.00		
" " "	Holyoke	43.00	33.65	21.34
" " "	Granby	40.00		
R. T. Prentiss' Corn Fertilizer	Easthampton	35.00		
" " "	Holyoke	36.00	25.42	33.75
" " "	Granby	34.00		
R. T. Prentiss' Potato and Vegetable	Easthampton	37.00		
" " " "	W. Springfield	36.00		
" " " "	Holyoke	37.50	28.87	26.83
" " " "	Granby	36.00		
Atlantic Fertilizer Co., Baltimore, Md.				
Rawson and Hodges' Peerless	N. Beverly	35.00	29.46	18.30
Rawson and Hodges' Garden Fertilizer	Beverly	27.00	19.26	40.19
Rawson and Hodges' Potato Fertilizer	Beverly	32.00	26.51	20.71
Rawson and Hodges' Corn and Grain Fertilizer	Bridgewater	30.00	18.09	65.33
Baltimore Pulverizing Co., Baltimore, Md.				
Market Garden Fertilizer	Dighton	30.00	19.37	54.88
Quality Brand Fertilizer	Dighton	33.00	27.11	40.17
Beach Soap Co., Lawrence, Mass.				
Beach's Advance Brand Fertilizer	Lawrence	33.00	27.26	21.06
Beach's Reliance Fertilizer	Lawrence	23.00	20.80	34.61
Beach's Market Garden Fertilizer	Lawrence	40.00	32.64	22.55
Beach's Top Dressing Fertilizer	Lawrence	47.00	41.31	13.77

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found	Total. Guaranteed.	Available. Found	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
366, 581, 613, 779, 957, 960	14.26	.53	.74	.51⊕	1.78	1.65	5.65	2.77	.74	9.16	8.50	8.42	8.00	2.62	2.00
141, 259	11.11	1.48	.36	.56	2.90	2.68	6.25	1.92	.89	9.06	8.50	8.17	8.00	4.67	4.00
270, 607	12.51	.84	1.65	.85	3.34	3.30	5.80	2.64	.69	9.13	8.50	8.44	8.00	6.33*	7.00
284, 622	10.32	.61	.87	.54	2.02	1.65	4.85	2.75	1.43	9.03	10.00	7.60	7.00	6.76	6.00
310, 621, 799	13.47	.96	.73	.56⊕	2.25	2.06	4.24	2.88	.79	7.91	7.00	7.12	6.00	3.04	2.00
276, 392, 849	12.09	.61	1.34	.72	2.67	2.47	3.57	2.60	.87	7.04	7.00	6.17	6.00	2.55	2.00
155, 277	12.04	.60	.72	.60	1.92	1.65	6.12	2.42	1.28	9.82	8.50	8.54	8.00	9.84*	10.00
138, 169	8.62	2.53	1.24	.60	4.37	4.11	6.95	1.59	.26	8.80	8.50	8.54	8.00	7.70*	7.00
715	12.16	1.59	2.09	.78	4.46	4.11	5.86	2.59	.94	9.21	8.50	8.27	8.00	7.14	7.00
530, 603	13.25	.56	.77	.51⊕	1.84	1.65	6.10	1.94	1.35	9.39	8.50	8.04	8.00	5.41	5.00
112	11.76	1.41	.90	.41	2.72	2.47	10.20	2.00	.38	12.58	12.50	12.20	12.00	9.40*	10.00
623	11.74	.72	1.42	.53	2.67	2.47	9.57	1.91	.77	12.25	12.50	11.48	12.00	11.12	10.00
917, 942, 1017	11.61	2.59	2.42	.83	5.84	5.76	4.97	1.61	.59	7.17	6.50	6.58	6.00	7.48	3.00
851, 943, 1015	13.56	1.20	1.17	.64	3.01	2.89	6.35	1.74	.99	9.08	8.50	8.09	8.00	3.04	3.00
916, 920, 944, 1018	12.92	1.61	1.36	.56	3.53	3.30	6.31	2.11	.74	9.16	8.50	8.44	8.00	9.85	10.00
487	9.78	1.81	1.28	.44	3.53	3.70	6.80	2.64	1.20	10.64	9.00	9.44	7.00	9.50	10.00
526	9.35	.70	1.06	.48	2.24	2.47	4.12	3.28	3.42	10.82	—	7.40	8.00	3.72	4.00
527	9.82	.93	1.59	.57	3.09	2.47	7.21	2.17	1.05	10.43	—	9.38	8.00	7.34	7.00
1043	9.21	.13	.80	.52⊕	1.45	1.65	8.07	1.70	.61	10.38	—	9.77	8.00	4.15	3.00
363	8.25	1.22	.65	.35⊕	2.22	2.46	5.93	1.83	.84	8.60	—	7.76	8.00	5.09	4.00
325	6.49	2.39	.61	.30⊕	3.30	3.04	5.40	2.30	.64	8.34	8.00	7.70	7.00	10.42	10.00
512	9.54	.75	1.56	.55	2.86	2.50	7.76	2.93	1.40	12.09	10.00	10.69	8.00	6.75*	6.00
510	8.42	.40	1.30	.44	2.14	1.65	2.59	7.18	3.67	13.44	10.00	9.77	8.00	3.55	3.00
509	7.25	2.32	1.84	.55	4.71	4.74	4.31	2.68	2.07	9.06	8.00	6.99	7.00	9.00*	9.75
513	4.32	2.00	3.00	.82	5.82	5.76	Trace	4.54	3.37	7.91	7.00	4.54	4.00	17.24	15.00

*No. 270–607 Chlorine 4.43%, equivalent to 5.89% potash, .99% potash as sulfate.
" 155–277 " 3.27% " 4.34% " 5.50% " "
" 138–169 " 5.07% " 6.74% " .96% " "
" 112 " 6.81% " 9.05% " .35% " "
" 512 " 1.06% " 1.40% " 5.35% " "
" 509 " .94% " 1.25% " 7.75% " "

⊕*Water insoluble* organic Nitrogen less than 50.00% active indicating that some low grade organic Nitrogen was used in the fertilizer.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Beach Soap Co., Lawrence, Mass.				
Beach's Lawn Dressing Fertilizer	Lawrence	$43.00	$26.54	62.02
Beach's Seeding Down Fertilizer	Lawrence	39.00	30.34	28.54
Berkshire Fertilizer Co., Bridgeport, Conn.				
Berkshire Complete Fertilizer	Sunderland	33.00	23.56	40.09
Berkshire Complete Fertilizer	N. Hadley	33.00	23.06	43.11
Berkshire Complete Fertilizer	Hadley	31.00		
" " "	Somerset	33.00		
" " "	W.Bridgew't'r	34.00	22.86	42.17
" " "	N. Hadley	32.00		
Berkshire Complete Tobacco Fertilizer	Hadley	32.00	25.14	27.29
Berkshire Complete Tobacco Fertilizer	Bradstreet	35.00	24.81	41.07
Berkshire Complete Tobacco Fertilizer	Sunderland	31.00		
" " " "	No. Hadley	32.00	24.74	26.64
" " " "	Easthampton	31.00		
Berkshire Potato and Vegetable Phosphate	Somerset	31.00	17.56	79.39
" " " " "	W.Bridgew't'r	32.00		
Berkshire Long Island Special	Sunderland	35.00	26.08	34.20
Berkshire Long Island Special	N. Hadley	33.00		
" " " "	Seekonk	35.00		
" " " "	Sunderland	33.50	25.58	34.09
" " " "	Hadley	33.00		
" " " "	W.Bridgew't'r	37.00		
Berkshire Grass Special	N. Hadley	33.00	24.43	35.08
" " "	Hadley	33.00		
Berkshire Ammoniated Bone Phosphate	Upton	32.00	15.74	103.30
Berkshire Tobacco Special with Carbonate of Potash	Sunderland	37.00	31.50	17.46
Berkshire Tobacco Special with Carbonate of Potash	N. Hadley	36.00	30.88	16.58
Berkshire Tobacco Special with Carbonate of Potash	N. Hadley	36.00		
" " " " " " "	Sunderland	35.00	28.58	24.77
" " " " " " "	N. Hadley	36.00		
Berkshire Economical Grass Fertilizer	Hadley	50.00	41.28	21.15
Bonora Chemical Co., 584 Broadway, N. Y. City				
Bonora	Boston	—	56.87	—
C. M. Bolles, East Pepperell, Mass.				
Nissitissitt Plant Food	Pepperell	50.00	31.12	57.46
" " "	Ayer	48.00		
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Alkaline Tobacco Grower	Northampton	31.50	27.23	15.68
Bowker's Early Potato Manure	Woburn	38.00	25.28	52.30
" " "	N. Abington	39.00		
Bowker's Lawn and Garden Dressing	Fall River	60.00	20.61	154.73
" " " " "	Concord	45.00		
Bowker's Market Garden Fertilizer	Northampton	33.50		
" " " "	Brockton	37.50		
" " " "	Concord	36.00	23.50	53.19
" " " "	Hudson	37.00		
Bowker's Potato and Vegetable Fertilizer	Northampton	28.50		
" " " " "	Leominster	32.00		
" " " " "	Franklin	30.00	21.28	47.56
" " " " "	N. Abington	32.50		
" " " " "	Holyoke	34.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Nitrogen in 100 lbs. Active Organic.	Nitrogen in 100 lbs. Inactive Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
495	8.47	2.17	1.40	.42	3.99	4.00	2.78	3.50	3.67	9.95	9.50	6.28	7.50	6.53	5.25
496	3.55	.20	1.14	.63	1.97	2.06	trace	6.59	9.90	15.49	15.00	6.59	—	16.69	15.00
69	10.63	1.25	.93	.84	3.02	2.50	4.66	3.58	1.02	9.26	9.00	8.24	8.00	6.90	6.00
96	10.09	1.69	.53	.50⊕	2.72	2.50	4.38	3.65	.92	8.95	9.00	8.03	8.00	7.41	6.00
350, 355, 400, 559	11.00	1.26	.94	.56	2.75	2.50	4.66	3.12	1.10	8.88	9.00	7.78	8.00	6.75	6.00
9	8.93	1.31	.98	.67	2.96	2.50	6.00	2.24	.64	8.88	9.00	8.24	8.00	7.06*	6.00
35	9.72	1.16	1.00	.63	2.79	2.50	6.12	2.40	.84	9.36	9.00	8.52	8.00	6.96*	6.00
163, 549, 701	9.91	.97	1.25	.72	2.94	2.50	5.68	2.84	.69	9.21	9.00	8.52	8.00	6.33*	6.00
331, 408	7.74	.52	.93	.64	2.09	1.70	3.29	2.53	1.02	6.84	7.00	5.82	6.00	4.98	4.00
61	9.65	1.64	1.36	.77	3.76	3.30	3.74	2.74	1.28	7.76	7.00	6.48	6.00	7.39	7.00
177, 293, 347, 371, 406	10.75	1.29	1.38	.85	3.52	3.30	3.74	2.43	1.25	7.42	7.00	6.17	6.00	7.90	7.00
176, 335	9.71	2.37	1.63	.89	4.89	5.00	.48	2.84	1.68	5.00	5.00	3.32	4.00	4.00	2.00
770	8.98	.07	.64	.73⊕	1.44	.80	5.04	2.66	1.10	8.80	9.00	7.70	8.00	3.46	2.00
50	8.36	.77	2.68	1.70	5.15	4.50	.74	3.54	.08	4.36	4.00	4.28	3.00	6.63*	5.60
77	9.54	.87	2.76	1.57	5.20	4.50	.67	3.79	.03	4.39	4.00	4.36	3.00	5.79*	5.60
174, 337, 550	10.63	1.71	2.10	1.44	5.26	4.50	.32	3.46	.38	4.16	4.00	3.78	3.00	5.81*	5.50
352	3.19	6.49	1.16	.49	8.14	8.00	trace	4.00	3.60	7.60	8.00	4.00	4.00	10.91	8.00
631	4.61	—	—	—	15.24	15.00	4.46	.13	none	4.59	—	4.59	5.00	4.69	3.00
648, 676	6.95	1.76	1.89	.68	4.33	4.00	2.36	3.38	4.72	10.46	10.00	5.74	4.50	10.00	10.00
221	6.65	.17	2.83	1.22	4.22	4.11	.51	2.85	4.52	7.88	5.00	3.36	4.00	6.03*	5.00
601, 794	12.92	1.51	1.33	.48	3.32	3.29	5.36	1.91	2.63	9.90	9.00	7.27	8.00	6.84	7.00
230, 459	9.23	2.04	.96	.30	3.30	3.29	3.32	1.35	.89	5.56	8.00	4.67	4.00	5.42	5.00
219, 472, 476, 881	11.63	.66	1.30	.43	2.39	2.47	3.89	2.46	1.61	7.96	7.00	6.35	6.00	9.84	10.00
206, 732, 738, 797, 923	12.58	.69	1.31	.47	2.47	2.47	5.61	2.65	2.17	10.43	9.00	8.26	8.00	4.60	4.00

*No. 9 Chlorine .77% equivalent to 1.02% potash, 6.03% potash as sulfate.
" 35 " .76% " 1.00% " 5.96% " " "
" 163-549-701 " 1.14% " 1.51% " 4.82% " " "
" 50 " .58% " .77% " 3.13% " " " 2.63% potash as carbonate, total potash 7.09%.

*No. 77 Chlorine .21% equivalent to .28% potash, 3.04% potash as sulfate 2.47% potash as carbonate, total potash 7.08%.

*No. 174-337-550 Chlorine .37% equivalent to .50% potash, 5.31% potash as sulfate, total potash 6.03%.
" 221 " .47% " .61% " 5.42% " " "

⊕Water insoluble organic Nitrogen less than 50.00% active, indicating that some low grade organic nitrogen was used in the fertilizer.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Continued).				
Bowker's Soluble Animal Fertilizer	Fall River	$32.00	$21.16	54.21
" " " "	Dighton	33.25		
Bowker's High Grade Fertilizer	Beverly	34.00	21.82	51.24
" " " "	Woburn	32.00		
Bowker's Cranberry Phosphate	Man'f't'r's sample	—	20.20	—
Bowker's Corn, Grain and Grass Fertilizer	Leominster	32.00	20.88	53.25
Bowker's "Square Brand" Fish and Potash	Northampton	27.00	16.09	70.92
" " " " " "	Dighton	28.00		
Bowker's Tobacco Starter	Conway	35.00	21.64	61.74
Bowker's Hill and Drill Phosphate	Northampton	28.50	19.79	55.79
" " " " "	Boston	32.00		
" " " " "	Leominster	32.00		
Bowker's Potato and Vegetable Phosphate	Taunton	31.00	15.65	93.08
" " " " "	Bridgewater	32.00		
" " " " "	Chelmsford	30.00		
Bowker's Farm and Garden Phosphate	Bridgewater	30.00	15.96	90.04
" " " " "	Hudson	31.00		
" " " " "	Sterling	30.00		
Bowker's Corn Phosphate	Lawrence	30.00	15.94	88.20
" " "	Chelmsford	30.00		
Bowker's Onion Fertilizer	Sunderland	—	28.26	—
Bowker's Onion Fertilizer	Sunderland	33.00	28.54	15.63
Bowker's Onion Fertilizer	Northampton	32.00	27.72	15.44
" " "	Sunderland	—		
Bowker's Sheep Manure	Boston	40.00	14.11	183.50
Bowker's Bristol Fish and Potash	N. Raynham	28.00	14.53	92.71
Bowker's Bone and Wood Ash Fertilizer	Fall River	40.00	14.37	127.35
" " " " " "	Beverly	30.00		
" " " " " "	Leominster	28.00		
Bowker's 10% Manure	Leominster	32.00	16.04	105.75
" " "	Hudson	34.00		
Bowker's Blood, Bone and Fish	W. Peabody	41.00	23.33	44.47
Bowker's Sure Crop Bone Phosphate	Lawrence	26.00	13.80	94.42
" " " " "	Leominster	28.00		
" " " " "	W. Acton	26.50		
Bowker's Potash Bone	Plymouth	23.00	11.85	136.28
Bowker's Gloucester Fish and Potash	Taunton	—	12.62	145.65
" " " " "	Franklin	31.00		
Bowker's Ammoniated Food for Flowers	Boston	—	19.13	—
Bowker's Highly Nitrogenized Manure	Man'f't'r's sample	—	41.71	—
Stockbridge's Spec. Comp. Man. for Tobacco	Northampton	42.50	33.44	27.09
Stockbridge's Spec. Comp. Man. for Top Dressing	Sunderland	37.50	27.23	37.46
Stockbridge's Sp. Com. Man. for Top Dress. & Forc'g	Northampton	36.00	27.23	23.25
" " " " " " " " "	Dighton	38.95		
Stockbridge's Sp. Comp. Man. Potatoes & Veget'bl's	Northampton	36.00	26.60	42.78
" " " " " " "	Dighton	38.95		
" " " " " " "	Bridgewater	39.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs							Potash (K_2O) in 100 lbs.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total. Found.	Total. Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
237 253	12.88	.57	1.51	.50	2.58	2.47	5.23	2.43	2.37	10.03	9.00	7.66	8.00	4.35	4.00
385 611	12.33	.36	1.14	.47	2.47	2.47	5.74	2.81	2.04	10.59	9.00	8.55	8.00	5.16	4.00
1060	15.12	.75	1.41	.47	2.63	2.47	6.10	2.76	1.73	10.59	10.00	8.86	9.00	2.22	2.00
736	10.74	.40	1.46	.49	2.38	2.47	6.35	2.02	2.14	10.51	9.00	8.37	8.00	4.24	4.00
207 291	9.54	.53	1.14	.53	2.20	2.47	3.00	1.41	1.38	5.79	5.00	4.41	4.00	3.92	4.00
907	10.04	1.30	.97	.60	2.87	2.47	5.84	2.33	.61	8.78	9.00	8.17	8.00	3.91*	3.00
205 534 730	11.57	.95	1.18	.37	2.50	2.47	6.63	2.12	1.99	10.74	10.00	8.75	9.00	2.45	2.00
346 465 616	12.56	.73	.62	.33	1.68	1.65	4.95	2.91	2.07	9.93	9.00	7.86	8.00	2.22	2.00
411 812 823	12.51	.72	.72	.29	1.73	1.65	5.78	2.16	2.04	9.98	9.00	7.94	8.00	2.20	2.00
497 609	10.84	.66	.69	.37	1.72	1.65	5.14	2.90	1.99	10.03	9.00	8.04	8.00	2.16	2.00
82	11.23	1.93	.62	.22	2.77	2.47	7.76	4.71	.87	13.34	13.00	12.47	12.00	7.68*	8.00
87	10.49	.65	1.22	.55	2.42	2.47	8.93	3.55	.66	13.14	13.00	12.48	12.00	8.31*	8.00
217 541	11.23	.59	1.23	.53	2.35	2.47	8.46	3.76	.71	12.93	13.00	12.22	12.00	8.04*	8.00
584	15.76	—	—	—	2.12	3.11	—	—	—	1.84	2.07	—	—	4.16†	1.78
1046	9.84	.47	.82	.33	1.62	1.65	3.32	3.01	1.40	7.73	7.00	6.33	6.00	2.91	2.00
303 603 717	10.65	.33	.89	.36	1.58	1.65	4.08	2.25	2.14	8.47	7.00	6.33	6.00	2.33	2.00
714 820	8.40	.43	.37	.16	.96	.82	3.29	2.04	1.10	6.43	6.00	5.33	5.00	8.83	10.00
521	10.89	1.21	2.10	.68	3.99	4.11	6.16	1.91	1.22	9.29	8.00	8.07	7.00	6.86	7.00
494 735 878	11.29	.27	.46	.23	.96	.82	5.84	3.06	1.51	10.41	9.00	8.90	8.00	2.20	2.00
614	15.59	.26	.44	.24	.94	.83	4.46	2.32	1.38	8.16	7.00	6.78	6.00	2.21	2.00
360 786	9.80	.11	.56	.29	.96	.82	5.29	2.77	2.09	10.15	9.00	8.06	8.00	1.24	1.00
630	3.56	1.95	.66	.22	2.83	2.47	.42	6.62	1.84	8.88	—	7.04	6.00	3.32*	2.00
1062	6.88	4.23	2.78	.85	7.91	8.23	1.47	4.61	1.02	7.10	8.00	6.08	7.00	9.49	8.00
226	6.47	4.05	.95	.48	5.48	5.76	2.84	2.09	.84	5.77	5.00	4.93	4.00	10.35*	10.00
92	10.52	3.14	1.36	.55	5.05	4.94	2.81	1.91	1.23	6.00	6.00	4.72	4.00	5.90	6.00
208 230	9.71	1.62	2.42	.75	4.79	4.94	2.61	2.01	.89	5.51	6.00	4.62	4.00	6.00	6.00
225 265 397	10.27	1.17	1.61	.51	3.29	3.29	4.06	2.06	1.56	7.68	7.00	6.12	6.00	9.95	10.00

*No. 907 Chlorine .33% equivalent to .44% potash 3.47% potash as sulfate.
" 82 " .30% " .40% " 7 28% " "
" 87 " .37% " .49% " 7.82% " "
" 217–541 " .74% " .98% " 7.06% " "
†No. 584 Total potash associated with organic matter, valued at 5c per pound.
*No. 630 Chlorine 1.86% equivalent to 2.46% potash .86% potash as sulfate.
" 226 " .80% " 1.06% " 9.29% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Continued).				
Stockbridge Sp. Comp. Man. for Corn and Grain . .	Sunderland .	$37.50	27.98	35.31
" " " " " " " " " . .	Northampton	36.00		
" " " " " " " " " . .	Dighton . . .	38.95		
" " " " " " " " " . .	Bridgewater	39.00		
Stockbridge Sp. Comp. Man. Corn & all Grain Crops	Sunderland . .	37.50	28.19	33.03
Stockbridge Sp. Comp. Man. Per. Dress. Seed. Down.	Northampton.	36.00	22.89	59.59
" " " " " " " " " .	Dighton . . .	37.06		
" " " " " " " " " .	Taunton . .	—		
Jos. Breck & Sons Corp., Boston, Mass.				
Breck's Market Garden Manure	Boston	31.00	20.04	54.69
Breck's Lawn and Garden Dressing	Boston	60.00	26.11	91.50
Ram's Head Brand Sheep Manure	Beverly	34.00	12.52	171.56
Buffalo Fertilizer Co., Buffalo, N. Y.				
Buffalo Fish Guano	Webster	27.00	15.08	79.04
Farmers' Choice	Milford . . .	28.00	15.46	34.35
" "	Sterling . . .	29.00		
Buffalo New England Special	Amherst	30.00	19.58	53.22
Buffalo New England Special	Chelmsford .	30.00	19.43	88.73
" " " "	Maynard . .	30.00		
" " " "	Holyoke . . .	32.00		
Celery and Potato Special	Amherst	36.00	22.90	57.21
Celery and Potato Special	Maynard . .	36.00	21.80	60.66
" " " "	Jefferson . .	34.00		
Buffalo Vegetable and Potato Fertilizer	Beverly . . .	34.50	22.52	57.64
" " " " "	Holyoke . . .	37.00		
" " " " "	Lee	35.00		
Buffalo High Grade Manure	Amherst	40.00	26.35	51.80
Buffalo High Grade Manure	Sunderland .	35.00	26.50	46.92
" " " "	Maynard . .	39.00		
" " " "	Jefferson . .	38.00		
Buffalo Tobacco Producer	N. Hadley . . .	36.10	29.38	22.87
Buffalo Tobacco Producer	Amherst	42.00	29.04	44.63
Buffalo Top Dresser	Amherst	42.00	30.12	39.44
Buffalo Top Dresser	Sunderland . .	39.00	31.51	23.77
E. D. Chittenden Co., Bridgeport, Conn.				
Chittenden's Potato and Grain	Sunderland . .	34.00	25.65	32.56
Chittenden's Potato and Grain	Hatfield	36.00	26.07	38.09
Chittenden's Comp. Tobacco and Onion Grower . .	Sunderland . .	35.00	24.18	44.75
Chittenden's Comp. Tobacco and Onion Grower . .	Sunderland . .	36.00	26.04	38.25
Chittenden's Grain and Vegetable Fertilizer	Sunderland . .	32.00	22.33	43.31
Chittenden's Connecticut Tobacco Grower	Sunderland .	44.00	31.06	43.27
" " " "	Hadley . . .	45.00		
Chittenden's Grass and Grain Fertilizer	Hatfield	38.00	23.50	61.70
Chittenden's Tobacco Special	Sunderland . .	36.00	26.07	38.09
Clay & Son, Stratford, London, England.				
Clay's London Fertilizer	Boston	90.00	18.90	376.20
Coe Mortimer Co., 51 Chambers St., N. Y. City.				
E. Frank Coe's Celebrated Special Potato Fertilizer	Southbridge .	36.00	16.90	107.10
" " " " " " "	Westfield . .	34.00		
E. Frank Coe's Columbian Corn & Potato Fertilizer	Southbridge .	29.50	15.16	96.24
" " " " " " "	Baldwinsville.	30.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
144, 218, 255, 410	10.65	1.35	1.36	.70	3.41	3.29	7.42	2.45	1.15	11.02	11.00	9.87	10.00	7.43	7.00
573	10.65	.75	2.01	.67	3.43	3.29	7.08	2.18	.92	10.18	11.00	9.26	10.00	7.75	7.00
223, 257, 330	9.28	1.05	.94	.29	2.28	2.47	3.89	2.25	1.51	7.65	9.00	6.14	6.00	10.25	10.00
585	12.92	.86	1.25	.42	2.53	2.47	6.25	2.75	2.25	11.25	10.00	9.00	9.00	2.21	2.00
562	8.84	1.58	1.90	.63	4.11	4.11	3.38	2.82	3.19	9.39	6.00	6.20	6.00	5.12	5.00
367	7.18	—	—	—	2.31	2.25	—	—	—	1.59	1.50	—	—	2.01†	1.50
861	13.40	.38	.55	.30	1.23	.80	4.27	4.86	1.43	10.56	10.00	9.13	9.00	2.54	2.00
763, 825	12.78	.32	.34	.24	.90	.80	3.95	4.09	1.30	9.34	9.00	8.04	8.00	5.61	5.00
156	13.37	.76	.58	.48⊕	1.82	1.60	5.84	3.83	1.30	10.97	10.00	9.67	9.00	4.78	5.00
529, 814, 941	12.67	1.00	.47	.25	1.72	1.60	5.55	3.56	1.05	10.16	10.00	9.11	9.00	5.98	5.00
81	11.46	.54	.80	.49⊕	1.83	1.60	5.59	2.54	1.51	9.64	9.00	8.13	8.00	9.82	10.00
810, 834	12.10	1.14	.40	.26⊕	1.80	1.60	4.21	3.95	1.15	9.31	9.00	8.16	8.00	9.53	10.00
394, 938, 1010	8.87	1.45	.58	.34	2.37	2.40	5.10	2.88	1.22	9.20	9.00	7.98	8.00	8.02	7.00
115	9.59	2.24	.62	.56⊕	3.42	3.30	5.17	2.12	.87	8.16	8.00	7.29	7.00	9.13	10.00
674, 811, 839	8.53	2.21	.72	.37	3.21	3.30	5.68	1.92	.87	8.47	8.00	7.60	7.00	9.50*	10.00
554	7.84	2.69	1.45	.78	4.93	4.51	3.19	2.94	2.42	8.56	5.00	6.13	—	5.64*	5.50
668	6.07	2.46	1.71	.73	4.90	4.51	3.19	2.57	2.40	8.16	6.00	6.76	—	5.60*	5.50
120	10.23	4.98	.50	.38	5.86	5.74	4.82	1.97	1.30	8.09	7.00	6.79	6.00	4.97	5.00
580	6.40	3.42	1.48	.59	5.49	5.74	4.60	1.60	1.15	7.25	7.00	6.10	—	6.59*	6.00
72	12.32	1.93	1.09	.37	3.39	3.30	7.05	1.14	.87	9.06	10.00	8.19	8.00	7.08	6.00
210	13.90	1.52	1.30	.56⊕	3.38	3.30	6.52	2.72	1.81	10.05	10.00	8.24	8.00	6.94	6.00
131	10.03	2.00	.90	.37	3.27	3.30	6.38	2.22	1.73	10.33	10.00	8.60	8.00	4.49‡	5.00
706	8.85	1.34	1.57	.55	3.46	3.30	6.12	1.94	2.09	10.15	10.00	8.06	8.00	5.37‡	5.00
149	13.73	.65	1.37	.51	2.53	2.47	6.83	1.59	.97	9.39	10.00	8.42	8.00	5.79	6.00
164, 415	8.33	2.97	1.21	.84	5.02	4.95	3.67	1.44	.99	6.10	6.00	5.11	4.00	8.54*	8.00
214	15.21	2.36	1.06	.41⊕	3.83	4.10	4.89	1.51	1.02	7.42	8.00	6.40	6.00	4.77	5.00
705	7.91	2.31	1.64	.63	4.48	4.30	3.06	.95	.71	4.72	5.00	4.01	3.00	6.25*	5.50
546	13.66	1.91	1.47	.72	4.20	4.00	.26	.91	5.97	7.14	7.00	1.17	1.12	.33	.08
860, 950	9.30	.38	.78	.56	1.72	1.65	4.66	2.97	1.12	8.75	9.00	7.63	8.00	3.88	4.00
891, 903	9.08	.44	.58	.35	1.37	1.23	5.17	3.20	1.30	9.67	9.50	8.37	8.50	2.71	2.50

†No. 367 Total potash, associated with organic matter, valued at 5 cents per pound.

⊕*Water insoluble* organic Nitrogen less than 50 .00% active indicating that some low grade organic nitrogen used in the fertilizer.

*No. 574–811–839 Chlorine 5.74% equivalent to 7.61% potash, 1.89% potash as sulfate.
" 554 " .11% " .15% " 5.49% " " "
" 668 " .43% " .56% " 5.04% " " "
" 580 " .45% " .58% " 6.01% " " "

‡Potash as Sulfate.

*No. 164–415 Chlorine .17% equivalent to .22% potash, 8.32% potash as sulfate.
" 705 " .22% " .30% " 5.95% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation
Coe Mortimer Co., (Continued.)				
E. Frank Coe's Excelsior Potato Fertilizer	Dighton	$38.00	$20.46	85.73
" " " " "	Grafton	38.00		
E. Frank Coe's Ammoniated Bone Superphosphate	Grafton	31.00	16.84	87.06
" " " " "	Lee	32.00		
E. Frank Coe's New Englander Corn and Grain	New Bedford	30.00	12.32	139.45
" " " " " " "	S.Williamst'n	29.00		
E. Frank Coe's Red Brand Excelsior Guano	Concord	34.00	25.97	27.72
" " " " " "	Concord	31.50		
" " " " " "	Concord	34.00		
E. Frank Coe's Special Grass Top Dressing	Dighton	38.00	22.72	67.25
E, Frank Coe'sXXV Ammo. Bone Superphosphate	Man'f't'r's sample	—	13.60	—
E. Frank Coe's Gold Brand Excelsior Guano	Dighton	36.00	24.27	48.33
" " " " " "	Baldwinsville	36.00		
E. Frank Coe'sComplete Manure with 10% Potash	New Bedford	38.00	22.04	72.42
E. Frank Coe's Standard Potato Fertilizer	Billerica	36.00	24.91	44.52
E. Frank Coe's Double Strength Potato Manure	Concord	36.00	30.15	19.40
Peruvian Vegetable Grower	Attleboro	41.00	28.16	45.60
Peruvian Guano Base Market Garden Fertilizer	Billerica	51.00	34.47	47.96
Peruvian Grass Top Dressing	Lynn	57.00	40.37	41.20
Peruvian Tobacco Fert. (Peruvian Guano Base)	Easthampton	53.00	35.11	50.97
Cowl's Special 4-6-6	N. Amherst	38.00	27.06	40.43
Cowl's Special 4-7-8	N. Amherst	40.30	30.42	32.48
Eastern Chem. Co., 37 Pittsburg St., Boston, Mass.				
I M P Plant Food	Boston	**	102.72	—
Essex Fertilizer Co., 39 N. Market St., Boston, Mass.				
Essex XXX Fish and Potash	Taunton	30.00	16.92	33.21
" " " " "	So.Fr'mingh'm	32.00		
Essex Complete Manure Potatoes, Roots and Veg.	Taunton	40.00	26.68	49.93
" " " " " " " "	Leominster	40.00		
Essex Market Garden and Potato Manure	Leominster	35.00	18.85	85.68
" " " " " "	Sterling	35.00		
Essex Complete Corn, Grain, and Grass	S.Framingh'm	40.00	26.77	50.35
" " " " " "	Southwick	40.50		
Essex Special Potato Phosphate	Sterling	40.00	21.75	83.90
Essex AI Superphosphate	S.Framingh'm	28.00	13.37	109.43
Essex Lawn Dressing	Taunton	45.00	25.63	65.82
" " "	Leominster	40.00		
Essex Potato Grower with 10% Potash	Spencer	39.00	23.58	65.39
Essex Grain and Grass Fertilizer	Webster	27.00	16.30	65.65
Essex Grass and Top Dressing	Marlboro	42.00	28.95	45.08
Essex Tobacco Starter and Grower	Southwick	38.00	25.88	46.83
C. W. Hastings, Dorchester, Mass.				
Ferti-Flara	Boston	**	19.42	—
Lister's Agricultural Chem. Works, Newark, N. J.				
Lister's 10% Potato Grower	So. Deerfield	40.00	26.84	49.03
Lister's High Grade Special for Spring Crops	Pepperell	35.00	22.36	58.76
" " " " " " " "	Marblehead	36.00		
Lister's Success Fertilizer	Pepperell	29.00	15.93	82.05
" " "	Hingham	29.00		

**No. 629 sold in small packages, 11 oz. for 25 cents.
No. 773 sold only in small bottles.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
362 760	8.62	1.07	.81	.35⊕	2.23	2.47	4.21	2.34	.82	7.37	8.00	6.55	7.00	7.54	8.00
768 1012	10.31	.64	.80	.44⊕	1.88	1.65	5.36	2.39	1.15	8.90	9.00	7.75	8.00	3.10	3.00
260 905	8.51	.35	.29	.24⊕	.88	.80	4.27	3.00	.94	8.21	8.50	7.27	7.50	2.89	3.00
343 375 382	10.64	1.04	1.57	.78⊕	3.39	3.30	3.00	4.85	.82	8.67	9.00	7.85	8.00	7.45	7.00
323	7.93	2.35	1.59	.56⊕	4.50	4.94	2.68	1.45	.36	4.49	5.00	4.13	4.00	3.26*	3.00
1059	7.83	.31	.36	.41⊕	1.08	.80	5.29	3.59	1.04	9.92	9.50	8.88	8.50	1.74	1.50
327 896	10.05	.88	1.78	.55	3.21	2.47	5.87	2.09	.66	8.62	9.00	7.96	8.00	5.79	6.00
287	9.44	1.15	.80	.54⊕	2.49	2.47	4.15	1.80	.84	6.79	7.00	5.95	6.00	8.80	10.00
801	10.15	1.55	.88	.63⊕	3.06	3.30	4.59	1.48	.87	6.94	7.00	6.07	6.00	9.71	10.00
377	8.49	1.53	1.86	.67	4.06	3.70	2.10	4.51	.69	7.30	8.50	6.61	7.00	11.00	10.00
274	8.04	1.55	1.22	.53	3.30	3.30	3.00	5.37	1.96	10.33	9.00	8.37	8.00	8.47*	9.00
537	9.47	2.77	1.68	.63	5.08	4.96	2.08	6.65	1.99	10.72	9.00	8.73	8.00	8.44*	10.00
785	7.29	4.41	2.99	.83	8.23	8.24	.93	4.17	2.27	7.37	6.00	5.10	4.50	5.98*	6.00
1035	7.89	1.23	2.71	.96	4.90	4.96	1.08	6.44	.26	7.78	7.00	7.52	6.00	10.39*	10.00
776	8.41	1.21	2.02	.70	3.93	4.00	2.27	4.04	2.42	8.73	7.00	6.31	6.00	6.16*	6.00
808	10.34	1.11	2.22	.74	4.07	4.00	2.04	4.95	3.34	10.33	—	6.99	7.00	8.00*	8.00
629	.32	13.36	—	—	13.36	13.00	25.76	none	none	25.76	25.30	25.76	—	26.10†	24.60
282 844	8.43	.36	1.15	.40	1.91	2.00	4.85	2.78	.89	8.62	9.00	7.63	8.00	3.08	3.00
254 696	7.01	.93	1.70	.56	3.19	3.28	4.34	2.40	.56	7.30	7.00	6.74	6.00	10.13	10.00
734 830	6.82	.37	1.16	.32	1.84	2.00	5.55	2.62	.84	9.01	9.00	8.17	8.00	5.12	5.00
843 935	6.28	.68	1.98	.56	3.22	3.28	3.95	2.61	.69	7.25	7.00	6.56	6.00	10.00	10.00
829	8.82	.56	1.41	.50	2.47	2.46	5.49	2.67	1.28	9.44	9.00	8.16	8.00	5.56	6.00
722	6.46	.16	.81	.40	1.37	1.20	3.87	2.94	1.05	7.86	8.00	6.81	7.00	2.08	2.00
279 729	5.92	2.17	1.21	.46	3.84	4.00	6.06	1.60	.38	8.04	8.00	7.66	7.00	6.03	6.00
1051	7.41	.90	1.25	.36	2.51	2.46	5.29	1.37	.36	7.02	7.00	6.66	6.00	9.72	10.00
893	7.63	.10	.56	.33	.99	.82	6.16	3.38	2.09	11.63	9.00	9.54	8.00	3.93	4.00
866	10.49	1.62	1.75	.56	3.93	4.00	6.12	1.33	1.48	8.93	8.00	7.45	7.00	8.67	8.00
925	6.59	1.20	2.08	.72	4.00	4.00	3.99	1.27	.71	5.97	5.00	5.26	4.00	6.13*	6.00
773	83.32	3.12	—	—	3.12	3.25	3.98	—	—	3.98	3.67	3.98	3.67	3.36‡	3.30
1020	11.40	1.64	1.09	.53	3.25	3.29	4.89	1.51	.97	7.37	—	6.40	6.00	10.76	10.00
656 778	11.79	.67	.65	.29	1.61	1.65	5.84	2.40	1.56	9.80	9.00	8.24	8.00	10.19	10.00
655 793	12.42	.55	.56	.29	1.40	1.23	6.44	2.79	1.79	11.02	10.00	9.23	9.00	2.38	2.00

⊕*Water insoluble* organic nitrogen less than 50.00% active indicating that some low grade organic nitrogen was used in the fertilizer.

*No. 323 Chlorine 1.88% equivalent to 2.50% potash, .76% potash as sulfate.
" 274 " .25% " .32% " 8.15% " " "
" 537 " .30% " .39% " 8.05% " " "
" 785 " .47% " .63% " 5.35% " " "
" 1035 " .62% " .81% " 9.58% " " "
" 776 " .45% " .58% " 5.58% " " "
" 808 " .57% " .75% " 7.25% " " "
" 925 " .94% " 1.23% " 4.90% " " "

†No Chlorine, potash as nitrate, valued at 5 cents per pound.
‡Potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Lister's Agricultural Chem. Works (Continued.)				
Lister's Special Corn Fertilizer	W.Bridgew'r	$33.00		
" " " "	Amherst	31.00	$15.38	103.70
" " " "	Hingham	30.00		
Lister's Special Potato Fertilizer	Fall River	32.50		
" " " "	Amherst	31.00		
" " " "	Pepperell	35.00	17.74	86.98
" " " "	Hingham	30.00		
" " " "	Williamstown	31.00		
Lister's Special Tobacco Fertilizer	Hadley	31.00	20.58	50.64
Lister's Potato Manure	Marlboro	38.00	26.42	43.83
Lister's Standard Grass Fertilizer	Webster	30.00	19.74	51.93
Lister's Complete Tobacco Manure	Amherst	37.50	23.73	58.03
James E. McGovern, Andover, Mass.				
Andover Animal Fertilizer	Lawrence	35.00	24.54	42.63
Mapes' Formula & Peruvian Guano Co., N. Y. City.				
Mapes' Potato Manure	Taunton	42.00	27.46	49.31
" " "	Southwick	40.00		
Mapes' Tobacco Starter	Southwick	37.00	25.39	49.66
" " "	Conway	39.00		
Mapes' Fruit and Vine Manure	Taunton	43.00	22.35	94.63
" " " " "	Worcester	44.00		
Mapes' Economical Potato Manure	Boston	39.00	25.06	55.63
Mapes' Vegetable or Complete Man. for Light Soils	Taunton	45.00	31.71	41.91
Mapes' Complete Manure for Heavy Soils	Boston	43.00	29.16	47.46
Mapes' Average Soil Complete Manure	Boston	39.00	26.89	45.04
" " " " "	Worcester	39.00		
Mapes' Cauliflower and Cabbage Manure	Boston	41.00	25.25	62.38
" " " " "	Worcester	41.00		
Mapes' Corn Manure	Taunton	38.00	22.21	71.10
" " "	Boston	38.00		
Mapes' Grass and Grain Spring Top Dressing	Taunton	44.00	30.51	44.19
Mapes' Lawn and Top Dressing	Taunton	34.00	14.19	139.60
Mapes' Complete Manure "A" Brand	Boston	38.00	21.53	76.50
Mapes' Complete Manure with 10% Potash	Enfield	33.00	20.70	59.42
Mapes' Complete Manure for General Use	Taunton	40.00	23.17	72.64
Mapes' Cereal Brand	Taunton	32.00	16.17	97.91
" " "	Conway	32.00		
Mapes' Top Dresser Improved—Half Strength	Southwick	34.00	21.07	61.37
Mapes' Tobacco Ash Constituent	Man'f't'r's'sample	—	26.17	—
Mapes' Wrapper Brand Tobacco Manure	Conway	50.00	41.25	21.21
" " " " "	Greenfield	50.00		
Mapes' Top Dresser, Improved—Full Strength	Southwick	54.00	42.28	27.72
Mapes' Grain Brand Fertilizer	Enfield	28.00	14.07	99.00
National Fertilizer Co., 92 State St. Boston, Mass.				
Chittenden's Complete Corn and Grain Fertilizer	Ayer	38.50		
" " " " " " "	Pepperell	38.50	25.21	52.04
" " " " " " "	Saundersville	38.00		
Chittenden's Fish and Potash	N. Hadley	30.00	20.16	48.81

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
					Total.					Total.		Available.			
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
437, 665, 795	13.98	.65	.53	.27	1.45	1.23	5.57	2.22	1.35	9.14	9.00	7.79	8.00	3.26	3.00
223, 664, 673, 804, 912	13.72	.55	.91	.37	1.83	1.65	5.74	2.53	2.04	10.31	9.00	8.27	8.00	3.35	3.00
994	11.33	.25	1.32	.71	2.28	2.06	5.65	2.71	3.27	11.63	9.00	8.36	8.00	3.16*	3.00
870	11.94	1.56	1.27	.46	3.29	3.29	5.65	2.87	2.22	10.64	9.00	8.42	8.00	7.44	7.00
890	11.81	.83	1.19	.38	2.40	2.47	7.05	2.08	1.66	10.79	10.00	9.13	9.00	2.50	2.00
669	3.60	2.25	1.11	.59	3.95	4.11	2.81	2.22	1.22	6.25	5.00	4.03	4.00	5.10*	5.00
503	10.15	.39	2.36	.98	3.73	3.00	.13	5.90	3.21	9.24	6.00	6.03	5.00	4.48	3.00
252, 485	4.70	2.13	1.12	.51⊕	3.76	3.71	1.31	6.65	1.22	9.18	8.00	7.96	8.00	7.25*	6.00
434, 897	11.22	2.27	1.66	.85⊕	4.78	4.12	none	6.28	3.39	9.67	8.00	6.28	6.00	1.76*	1.00
263, 755	13.92	.66	.81	.60⊕	2.07	1.65	none	3.73	4.36	8.09	7.00	3.73	5.00	10.04*	10.00
557	7.94	2.17	.80	.53⊕	3.50	3.29	.93	3.89	1.51	6.33	6.00	4.82	4.00	8.31*	8.00
236	8.64	3.10	1.47	.70⊕	5.27	4.94	1.19	5.98	1.56	8.73	8.00	7.17	6.00	6.85*	6.00
551	9.36	2.54	1.69	.74⊕	4.97	4.94	.96	7.43	2.40	10.79	10.00	8.39	8.00	3.68*	3.00
558, 738	9.31	2.97	.90	.55⊕	4.42	4.12	1.40	5.82	.84	8.06	8.00	7.22	7.00	5.40*	5.00
544, 741	10.66	3.00	.70	.49⊕	4.19	4.12	.93	5.55	1.05	7.53	6.00	6.48	6.00	6.11	6.00
239, 532	10.34	.71	1.07	.69⊕	2.47	2.47	.80	6.83	3.60	11.23	10.00	7.63	8.00	6.21	6.00
267	7.44	2.02	2.13	.87⊕	5.02	4.94	.55	5.29	1.94	7.78	6.00	5.84	5.00	7.69	7.00
238	12.84	1.92	.37	.31⊕	2.60	2.47	.99	2.38	1.02	4.39	3.00	3.37	2.00	2.61	2.50
561	10.11	1.17	1.01	.61⊕	2.69	2.47	.89	8.42	3.83	13.14	12.00	9.31	10.00	3.10	2.50
952	9.78	.99	.60	.47⊕	2.06	2.06	.48	4.19	1.22	5.89	5.00	4.67	3.00	10.56	10.00
243	11.74	1.26	1.35	.56⊕	3.17	3.29	1.02	6.81	2.96	10.79	10.00	7.83	8.00	4.40	4.00
262, 894	10.44	.62	.82	.56⊕	2.00	1.65	.68	4.42	3.29	8.39	8.00	5.10	6.00	3.77	3.00
1016	3.36	3.35	.95	.36⊕	4.66	4.94	.57	1.90	1.61	4.08	4.00	2.47	2.50	2.62*	2.00
1048	9.47	.20	.42	.29⊕	.91	.50	.15	1.90	4.41	6.46	5.70	2.05	—	14.73*	15.00
898, 902	9.09	2.80	2.56	.92	6.28	6.18	.23	4.75	.99	5.97	4.50	4.98	—	10.41*	10.50
940	5.52	9.24	.48	.23	9.95	9.88	.19	6.86	.51	7.56	8.00	7.05	5.00	4.17*	4.00
956	9.13	.17	.35	.42⊕	.94	.82	.77	6.70	1.51	8.98	—	7.47	8.00	4.46	4.00
680, 710, 719	10.57	.81	1.74	.69	3.24	3.29	6.12	1.91	1.15	9.18	9.00	8.03	8.00	6.35	6.00
80	11.80	.70	1.48	.60	2.78	2.88	4.91	1.95	1.35	8.21	7.00	6.86	6.00	3.62	4.00

⊕*Water insoluble* organic nitrogen less than 50.00% active, indicating that some low grade organic nitrogen was used in the fertilizer.

*No. 994 Chlorine .37% equivalent to .49% potash, 2.67% potash as sulfate.
" 669 " .87% " 1.15% " 3.95% " "
" 252–485 " .59% " .78% " 6.47% " "
" 484–897 " .25% " .34% " 1.42% " "
" 263–755 " .79% " 1.04% " 9.00% " "
" 551 " .67% " .87% " 2.81% " "
" 557 " .32% " .43% " 7.88% " "
" 236 " 1.06% " 1.41% " 5.44% " "
" 558–738 " .35% " .44% " 4.96% " "
" 1016 " .92% " 1.22% " 1.40% " "
" 1048 " 1.76% " 2.34% " 4.24% " " 8.15% potash as carbonate.
" 898–902 " .67% " 87% " 3.41% " " 6.13% potash as carbonate.
" 940 " .79% " 1.05% " 3.12% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
National Fertilizer Co. (Continued.)				
Chittenden's Fish and Potash	N. Hadley			
" " " "	Ayer	$30.12	$19.85	50.98
" " " "	Pepperell	28.50		
" " " "	W.Springfield	28.00		
Chittenden's XXX Fish and Potash	Ayer	29.50		
" " " " "	Saundersville	30.00	19.71	54.74
" " " " "	Hadley	32.00		
Chittendens' Market Garden Fertilizer	Sunderland	—	24.91	—
Chittenden's Market Garden Fertilizer	Sunderland	33.00		
" " " "	W.Bridgewa'r	37.00	22.54	53.64
" " " "	Sunderland	33.00		
" " " "	Ayer	35.50		
Chittenden's Ammoniated Bone Phosphate	Leominster	30.00	16.05	90.04
" " " "	Saundersville	31.00		
Chittenden's High Grade Special Tobacco Fert.	Hadley	44.00	35.66	23.42
Chittenden's Potato Phosphate	W.Bridgewa'r	34.00	19.94	60.48
" " "	Pepperell	30.00		
Chittenden's Complete Root Fertilizer	Bradstreet	34.00	27.13	25.32
Chittenden's Complete Root Fertilizer	So. Deerfield	35.00	25.98	34.72
Chittenden's Complete Root Fertilizer	Sunderland	36.00		
" " " "	Concord	34.00		
" " " "	Bradstreet	35.00	25.79	32.61
" " " "	Sunderland	32.00		
" " " "	W.Springfield	34.00		
Chittenden's Complete Tobacco Fertilizer	Hadley	34.00	27.18	25.09
Chittenden's Complete Tobacco Fertilizer	Bradstreet	36.00	26.47	36.00
Chittenden's Complete Tobacco Fertilizer	Bradstreet	36.00	26.73	34.68
Chittenden's Complete Tobacco Fertilizer	N. Hadley	33.00		
" " " "	Sunderland	36.00	25.35	38.07
" " " "	Sunderland	36.00		
Chittenden's Complete Tobacco Fertilizer	Bradstreet	34.00		
" " " "	N. Hadley	36.00	24.57	43.48
" " " "	Bradstreet	35.00		
" " " "	W.Springfield	36.00		
Chittenden's Connecticut Valley Tobacco Grower	Bradstreet	46.00	35.70	28.85
Chittenden's Connecticut Valley Tobacco Grower	N. Hadley	46.00	35.90	28.13
Chittenden's Connecticut Valley Tobacco Grower	Bradstreet	46.00	35.12	30.98
Chittenden's Connecticut Valley Tobacco Starter	N. Hadley	46.00	34.87	31.92
Chittenden's Connecticut Valley Tobacco Starter	Bradstreet	46.00	37.71	21.98
Chittenden's Tobacco Spec. with Carbonate of Potash	Hadley	35.00	28.47	22.94
Chittenden's Tobacco Spec. with Carbonate of Potash	Hadley	35.00	29.64	18.09
Chittenden's Tobacco Spec. with Carbonate of Potash	N. Hadley	—	30.61	—
Chittenden's Tobacco Spec. with Carbonate of Potash	N. Hadley	35.00	32.06	9.17
Chittenden's Tobacco Spec. with Carbonate of Potash	Sunderland	36.00		
" " " " " "	Hadley	35.00	28.11	25.68
" " " " " "	Bradstreet	35.00		
Chittenden's Tobacco Special	N. Hadley	34.50	27.97	26.03
" " "	Hadley	36.00		
Chittenden's Complete Grass Fertilizer	Hadley	36.00		
" " " "	Leominster	38.00	23.58	61.16
" " " "	Ayer	40.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total. Found.	Total. Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found	Guaranteed.
171, 646, 689, 953	12.44	.81	1.26	.48	2.55	2.88	4.44	2.83	1.53	8.80	7.00	7.37	6.00	4.03	4.00
649, 693, 984	9.29	.81	1.33	.59	2.73	2.47	3.89	2.26	1.91	8.06	6.00	6.15	5.00	3.97	3.00
90	13.53	1.51	.59	.23	2.33	2.47	6.29	2.18	1.07	9.54	9.00	8.47	8.00	6.02	6.00
339, 448, 455, 643	11.53	1.01	1.19	.40	2.60	2.47	6.31	1.85	1.66	9.82	9.00	8.16	8.00	6.03	6.00
641, 718	11.14	.60	.79	.33	1.72	1.65	5.10	3.06	2.04	10.20	9.00	8.16	8.00	2.11	2.00
993	8.08	2.29	2.66	.81	5.76	5.76	3.06	1.71	.87	5.64	6.00	4.77	5.00	10.02*	10.00
450, 684	12.39	.70	.87	.44	2.01	2.06	6.00	2.01	2.04	10.05	9.00	8.01	8.00	5.45	6.00
20	11.48	1.12	1.70	.52	3.34	3.29	6.54	2.85	1.43	10.82	9.00	9.39	8.00	6.98	6.00
46	11.48	1.06	1.71	.64	3.41	3.29	5.84	1.94	1.99	9.77	9.00	7.78	8.00	6.57	6.00
342, 374, 587, 703, 946	11.80	1.11	1.81	.49	3.41	3.29	6.25	2.02	1.30	9.57	9.00	8.27	8.00	6.20	6.00
8	9.12	1.60	1.37	.61	3.58	3.29	5.84	3.11	2.91	11.86	9.00	8.95	8.00	5.29*	5.00
17	9.64	1.64	1.26	.57	3.47	3.29	6.00	2.82	2.63	11.45	9.00	8.82	8.00	5.30*	5.00
37	9.28	1.68	1.22	.57	3.47	3.29	5.91	2.97	2.78	11.66	9.00	8.88	8.00	5.42*	5.00
117, 166, 195	10.03	1.90	1.13	.40	3.43	3.29	5.74	2.76	1.81	10.31	9.00	8.50	8.00	5.05†	5.00
426, 564, 595, 918	10.52	1.45	1.30	.41	3.16	3.29	5.23	3.19	2.32	10.74	9.00	8.42	8.00	5.08*	5.00
18	9.18	.16	3.52	1.37	5.05	4.94	none	2.91	2.12	5.03	4.00	2.91	1.00	8.45*	8.00
78	9.38	.22	3.23	1.52	4.97	4.94	.77	2.85	1.53	5.15	4.00	3.62	1.00	7.93‡	8.00
699	9.81	.26	3.36	1.57	5.19	4.94	.74	1.71	2.07	4.52	4.00	2.45	1.00	7.31‡	8.00
95	7.92	5.27	1.71	1.10	8.08	8.23	.41	3.98	.87	5.26	4.00	4.39	3.00	2.95*	2.50
588	9.60	4.11	3.23	1.37	8.71	8.23	.77	3.29	.66	4.72	4.00	4.06	3.00	2.58†	2.50
6	9.98	.29	2.97	1.38	4.64	4.53	trace	2.75	2.91	5.66	4.00	2.75	3.00	4.76*	5.50
13	10.01	.29	2.85	1.41	4.55	4.53	.48	2.61	2.78	5.87	4.00	3.09	3.00	5.58*	5.50
74	10.13	.16	3.42	1.31	4.89	4.53	.26	3.34	1.99	5.59	4.00	3.60	3.00	5.06*	5.50
98	10.02	.23	3.08	1.56	4.87	4.53	.64	3.14	2.32	6.10	4.00	3.78	3.00	5.46‡	5.50
151, 188, 417	9.31	.48	2.92	1.16	4.56	4.53	trace	3.95	2.86	6.81	4.00	3.95	3.00	5.96*	5.50
667, 985	9.75	.14	3.16	1.21	4.51	4.33	.26	4.33	2.22	6.81	4.00	4.59	3.00	5.58*	5.50
187, 642, 681	10.79	2.51	1.02	.33	3.86	4.11	3.95	2.07	1.48	7.50	7.00	6.02	6.00	5.10	5.00

*No. 993 Chlorine .27% equivalent to .36% potash, 9.66% potash as sulfate.
" 8 " .31% " .41% " 4.88% " "
" 17 " .53% " .71% " 4.59% " "
" 37 " .21% " .28% " 5.14% " "
" 426-564-595-918 " .92% " 1.21% " 3.87% " "
" 18 " .45% " .60% " 1.04% " " 6.81% potash as carbonate.
" 95 " .38% " .51% " 2.44% " "
" 6 " .37% " .49% " .79% " " 3.48% potash as carbonate, Total Potash 5.43%.

*No. 13 Chlorine .32% equivalent to .41% potash, .99% potash as sulfate 4.18% potash as carbonate, Total Potash 6.43%.

*No. 74 Chlorine .04% equivalent to .06% potash, .98% potash as sulfate 4.02% potash as carbonate, Total Potash 7.13%.

*No. 151-188-417 Potash as sulfate. Total potash 6.90%.

*No. 667-985 Chlorine .67% equivalent to .89% potash, 4.69% potash as sulfate.

†Potash as sulfate. ‡Potash as carbonate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
National Fertilizer Co. (Continued.)				
Chittenden's Eureka Potato Fertilizer	Ayer	$36.50	$23.95	53.42
" " " "	Saundersville	37.00		
Chittenden's High Grade Top Dressing	N. Hadley	48.00	39.60	21.21
Chittenden's High Grade Top Dressing	Ayer	66.00	44.93	22.41
" " " " " "	Saundersville	65.00		
Chittenden's Tobacco Special with Sulfate	Man'f't'r's sample	—	24.89	—
Natural Guano Co., Aurora, Ill.				
Pulverized Sheep Manure	Fitchburg	32.00	13.53	136.51
New England Fert. Co., 40 N. Market St., Boston, Mass.				
New England Corn Phosphate	Brockton	32.00	16.78	81.76
" " " "	Marblehead	29.00		
New England Potato Fertilizer	Brockton	32.00	15.61	98.60
" " " "	Marblehead	30.00		
New England High Grade Potato Fertilizer	Brockton	35.00	22.55	55.21
New England Corn and Grain Fertilizer	Marblehead	26.50	13.26	100.00
New England Superphosphate—All Crops	Brockton	34.00	19.72	72.42
New England Top Dressing Grass and Grains	Brockton	41.00	26.42	66.19
New England Complete Manure	Brockton	38.00	26.11	45.54
New England Mineral Fertilizer & Chem. Co., Boston,				
New Mineral Fertilizer	Manf't'r's sample	17.00	2.30	639.20
Nitrate Agencies Co., New York City.				
Peruvian Guano	Sunderland	28.00	19.44	44.03
Olds and Whipple, Hartford, Conn.				
Olds & Whipple Complete Onion Fertilizer	No. Hadley	33.00	25.00	32.00
" " " " "	No. Hadley	33.00		
Olds & Whipple Complete Onion Fertilizer	Hatfield	35.00	25.62	32.71
" " " " "	Bradstreet	33.00		
Olds & Whipple Complete Grass Fertilizer	Man'f't'r's sample	—	25.40	—
Olds & Whipple Complete Tobacco Fertilizer	Bradstreet	37.00	30.11	22.88
Olds & Whipple Complete Tobacco Fertilizer	N. Hadley	36.00	31.44	14.50
Olds & Whipple Complete Tobacco Fertilizer	N. Hadley	36.00	31.30	15.81
" " " " "	N. Hadley	36.00		
" " " " "	Sunderland	36.00		
" " " " "	Hadley	37.00		
Olds & Whipple Complete Tobacco Fertilizer	Sunderland	38.00	29.01	26.41
" " " " "	Hadley	35.00		
" " " " "	Bradstreet	37.00		
Olds & Whipple Complete Tobacco Fertilizer	N. Hadley	36.00	26.24	37.19
Olds & Whipple High Grade Potato Fertilizer	N. Hadley	36.00	31.57	14.03
Olds & Whipple Fish and Potash	So. Deerfield	30.00	19.05	57.48
Olds & Whipple Complete Corn & Potato Fertilizer	Whately	35.00	24.46	43.09
Parmenter & Polsey Fert. Co., Boston, Mass.				
P. & P. Plymouth Rock Brand	Whitman	35.00	18.96	70.34
" " " "	N. Attleboro	33.00		
" " " "	W. Acton	34.00		
" " " "	Adams	34.00		
P. & P. Special Potato Fertilizer	N. Attleboro	39.00	25.33	53.97
P. & P. A.A. Brand	Auburn	39.00	27.77	40.44
P. & P. Potato Fertilizer	Whitman	35.00	18.36	81.54
" " "	N. Attleboro	32.00		
" " "	Adams	33.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.: As Nitrates and Ammoniates.	Nitrogen: Active Organic.	Nitrogen: Inactive Organic.	Nitrogen Total: Found.	Nitrogen Total: Guaranteed.	Phosphoric Acid in 100 lbs.: Water Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid Total: Found.	Phosphoric Acid Total: Guaranteed.	Phosphoric Acid Available: Found.	Phosphoric Acid Available: Guaranteed.	Potash (K_2O) in 100 lbs.: Found.	Potash (K_2O): Guaranteed.
682, 725	9.77	1.43	.71	.36	2.50	2.47	4.34	2.07	1.63	8.04	7.00	6.41	6.00	10.43	10.00
101	5.86	6.33	1.11	.37	7.81	8.43	4.06	2.83	1.12	8.01	7.25	6.89	6.25	8.31	8.00
645, 724	5.67	2.01	4.78	1.65	8.44	8.43	1.53	2.94	1.45	5.92	7.25	4.47	6.25	9.96	8.00
1050	7.59	1.73	1.54	.75	4.02	4.53	2.40	2.04	1.56	6.00	4.00	4.44	3.00	5.78†	5.00
635	7.47	—	—	—	2.34	2.25	—	—	—	2.50	1.75	—	—	2.17‡	1.50
433, 628	10.08	.08	1.14	.39	1.61	1.64	6.99	1.10	1.81	9.90	9.00	8.09	8.00	2.95	3.00
466, 620	8.24	.40	.79	.39	1.58	1.64	5.46	1.33	.79	7.58	8.00	6.79	7.00	3.90	4.00
464	9.80	.83	1.14	.54	2.51	2.46	6.28	2.01	.84	9.13	9.00	8.29	8.00	6.55	6.00
627	7.01	.14	.79	.34	1.27	1.23	4.08	2.86	1.20	8.14	8.00	6.94	7.00	2.17	2.00
463	8.34	.88	1.13	.40	2.41	2.46	6.85	1.19	.38	8.42	9.00	8.04	8.00	4.13	4.00
462	9.16	.98	2.12	.71	3.81	4.11	6.12	1.30	.97	8.39	8.00	7.42	7.00	5.91	6.00
432	7.86	.81	1.67	.60	3.08	3.28	4.59	1.69	.54	6.82	7.00	6.28	6.00	10.28	10.00
1002	.65	.47	—	—	.63	.45	—	—	—	.24	.23	—	—	.18*	.10
57	8.44	1.02	.97	.32	2.31	2.34	1.19	7.41	5.71	14.31	—	8.60	7.90	2.05	2.44
111, 118	9.39	.71	1.69	1.16	3.56	3.30	.45	5.37	1.63	7.45	7.00	5.82	6.00	7.02	6.50
216, 420	10.93	.38	2.03	1.30	3.71	3.30	.13	5.40	1.51	7.04	7.00	5.53	6.00	7.10	6.50
1026	12.54	.67	1.87	1.10	3.64	3.30	.57	5.37	1.79	7.73	7.00	5.94	6.00	6.88	6.00
19	7.65	.76	2.86	1.36	4.98	4.50	trace	3.72	.18	3.90	3.50	3.72	3.00	6.02**	5.50
99	7.60	.70	3.13	1.02	4.85	4.50	none	3.77	.13	3.90	3.50	3.77	3.00	6.08**	5.50
122, 159, 168, 192	8.08	.73	2.49	1.56	4.77	4.50	trace	3.57	.33	3.90	3.50	3.57	3.00	6.69**	5.50
340, 418, 443	6.91	.82	2.26	1.58	4.66	4.50	trace	3.44	.41	3.85	3.50	3.44	3.00	5.76**	5.50
583	8.33	.31	2.38	1.84	4.53	4.50	none	3.57	.43	4.00	3.50	3.57	3.00	5.42**	5.50
160	7.84	.94	1.89	1.01	3.84	3.30	1.44	5.09	1.71	8.24	7.00	6.53	6.00	11.97**	10.00
1025	13.45	.16	1.65	.93⊕	2.74	2.50	2.07	3.80	.51	6.38	6.00	5.87	5.00	3.67	3.00
1021	10.27	.78	1.69	1.01	3.48	3.30	.51	5.74	1.35	7.60	7.00	6.25	6.00	6.34**	6.00
445, 789, 831, 1005	9.03	.67	1.27	.46	2.40	2.46	5.68	2.24	1.14	9.06	9.00	7.92	8.00	4.17	4.00
790	9.04	.87	1.81	.57	3.25	3.23	6.84	1.54	.92	8.30	9.00	7.38	8.00	7.26	7.00
1038	9.00	1.37	1.91	.73	4.01	4.10	4.66	2.16	.86	7.68	8.00	6.82	7.00	7.73	8.00
460, 783, 1007	7.37	.13	1.24	.47	1.84	1.64	4.12	1.98	1.12	7.22	7.00	6.10	6.00	6.30	6.00

†Potash as sulfate. *No. 1002 Acid Soluble Potash 1.04%.

‡Total potash, associated with organic matter, valued at 5 cents per pound.

**No. 19 Chlorine .68% equivalent to .90% potash, 2.02% potash as sulfate, 3.10% potash as carbonate.

**No. 99 Chlorine .21% equivalent to .27% potash, 5.81% potash as carbonate.

**No. 122–159–168–192 Chlorine .23% equivalent to .31% potash, 1.09% potash as sulfate, 5.29% potash as carbonate. Total Potash 6.96%.

**No. 340–418–443 Chlorine .42% equivalent to .57% potash, 1.10% potash as sulfate, 4.09% potash as carbonate, Total potash 6.31%.

**No. 583 Chlorine .42% equivalent to .57% potash, 4.85% potash as sulfate.
" 160 " 5.34% " 7.09% " 4.88% " "
" 1021 " 3.86% " 5.14% " 1.20% " "

⊕*Water Insoluble* organic nitrogen less than 50.00% active, indicating that some low grade organic nitrogen was used in the fertilizer.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Parmenter & Polsey Fert. Co. (Continued.)				
P. & P. Potato Grower with 10% Potash	W. Acton	$38.00	$23.45	64.18
" " " " " "	Adams	39.00		
P. & P. Star Brand Superphosphate	Whitman	35.00	16.11	117.25
P. & P. Aroostook Special	Adams	43.50	28.12	54.70
P. & P. Grain Grower	Adams	28.50	13.35	113.50
P. & P. Maine Potato Fertilizer	Groton	39.50	25.38	55.63
P. & P. Lawn Dressing	N. Attleboro	—	24.65	—
Patron's Co-operative Association, Boston, Mass.				
Top Dressing	Sunderland	35.50	26.92	31.87
Onion Fertilizer	Sunderland	35.00	26.84	30.40
Pulverized Manure Co., Chicago, Ill.				
Pulverized Sheep Manure	Fall River	25.00	13.02	97.16
" " "	W. Springfield	24.00		
" " "	Concord	28.00		
Rogers Manufacturing Co., Rockfall, Conn.				
All Round Fertilizer	Worcester	32.00	17.34	78.78
" " "	Sterling	30.00		
Complete Potato and Vegetable Fertilizer	So. Deerfield	34.00	21.96	54.83
Complete Potato and Vegetable Fertilizer	N. Amherst	31.00	21.70	52.08
" " " " "	Worcester	35.00		
Complete Potato and Vegetable Fertilizer	Sterling	34.00	21.26	59.92
Complete Corn and Onion Fertilizer	Deerfield	35.50	28.85	23.05
Fish and Potash	Worcester	33.00	21.58	52.92
High Grade Oats and Top Dressing	Sunderland	45.00	37.33	20.55
High Grade Oats and Top Dressing	Sunderland	—	35.67	28.96
" " " " " "	Taunton	46.00		
High Grade Oats and Top Dressing	N. Amherst	45.00	36.53	23.19
High Grade Fertilizer for Grass and Grain	N. Amherst	42.00	35.45	18.48
" " " " " " "	Plainville	41.50		
" " " " " " "	Deerfield	42.50		
High Grade Soluble Tobacco & Potato Manure	N. Amherst	38.00	31.95	22.69
" " " " " " "	Fitchburg	40.00		
" " " " " " "	Plainville	38.50		
" " " " " " "	Deerfield	38.50		
" " " " " " "	W. Springfield	41.00		
High Grade Soluble Tobacco Manure	N. Amherst	43.00	37.97	15.88
" " " " "	Fitchburg	46.00		
" " " " "	Deerfield	43.50		
" " " " "	W. Springfield	44.00		
High Grade Soluble Tobacco Manure	Buckland	43.50	36.31	19.80
High Grade Tobacco Grower	N. Hadley	40.00	29.66	34.86
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's Bone Base Complete Phosphate	Hadley	29.00	18.19	62.18
" " " " "	N. Westport	30.00		
" " " " "	E. Milton	30.00		
" " " " "	Rockland	29.00		
Hubbard's Bone Base Potato Phosphate	Hadley	34.00	21.72	58.38
" " " " "	N. Westport	34.00		
" " " " "	E. Milton	35.00		
" " " " "	Upton	35.00		
" " " " "	N. Hanover	34.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
837, 1009	8.18	1.13	.90	.50	2.63	2.46	5.23	.69	.40	6.32	7.00	5.92	6.00	10.37	10.00
431	9.55	.41	.34	.42	1.67	1.64	5.10	1.66	.56	7.32	8.00	6.76	7.00	4.26	4.00
1006	3.61	1.91	1.33	.49	3.73	3.69	6.61	.68	.51	7.80	8.00	7.29	7.00	9.46	10.00
1004	6.62	.10	.75	.41	1.26	1.23	4.08	2.86	1.12	8.06	8.00	6.94	7.00	2.33	2.00
671	6.70	1.37	1.20	.49	3.06	3.28	4.78	1.58	.76	7.12	7.00	6.36	6.00	9.86	10.00
782	5.36	3.31	.27	23	3.81	4.11	6.19	1.51	.08	7.78	8.00	7.70	7.00	6.18	5.00
457	9.51	1.34	1.37	.94	4.15	4.12	none	3.96	3.54	7.50	8.00	3.96	—	8.47	8.00
575	11.19	1.42	2.10	.72	4.24	4.12	none	5.22	4.28	9.50	10.00	5.22	—	6.03	5.00
299, 955, 379	10.73	—	—	—	2.31	1.80	—	—	—	2.04	—	—	1.00	2.15†	1.00
747, 827	13.13	.79	.91	.44	2.14	1.65	4.02	3.68	2.42	10.12	10.00	7.70	8.00	2.21	1.65
49	11.29	.45	1.31	.64	2.40	2.25	4.82	4.16	1.02	10.00	10.00	8.98	8.00	5.46	5.00
451, 745	11.59	.51	1.43	.51	2.45	2.25	3.64	4.47	1.51	9.62	10.00	8.11	8.00	5.70	5.00
815	10.30	.53	1.08	.53	2.14	2.25	3.67	6.13	.74	10.54	10.00	9.80	8.00	5.44	5.00
850	3.61	77	2.41	.84	4.02	3.60	2.53	3.77	2.02	8.32	8.00	6.30	6.00	8.56	7.00
750	11.28	1.23	1.45	.73	3.41	3.25	1.02	3.66	2.44	7.12	6.00	4.68	4.00	4.81	3.75
60	5.74	3.02	2.71	.79	6.52	6.30	1.08	6.47	2.07	9.62	9.00	7.55	7.00	7.87	7.50
139, 365	4.90	4.51	1.33	.54	6.38	6.30	.93	6.06	2.32	9.31	9.00	6.99	7.00	8.40	7.50
422	3.59	3.01	2.35	.85	6.21	6.30	.74	6.76	1.56	9.06	9.00	7.50	7.00	8.70	7.50
412, 663, 914	9.09	.30	2.03	.70	3.03	3.00	trace	13.09	5.18	18.27	16.00	13.09	—	12.98	12.50
427, 644, 666, 852, 937	9.41	.84	2.30	.95	4.09	3.50	.61	6.92	2.19	9.72	8.00	7.53	7.00	9.45*	8.75
414, 674, 854, 954	8.51	1.11	3.03	1.11	5.25	5.00	.51	6.91	1.94	9.36	8.00	7.42	6.00	11.23*	11.00
997	6.18	1.32	2.62	1.01	4.95	5.00	.77	5.21	3.08	9.06	8.00	5.98	6.00	11.57*	11.00
991	10.18	1.44	2.42	1.02	4.88	5.00	.45	4.42	2.07	6.94	5.00	4.87	4.00	6.64*	6.00
180, 300, 473, 803	9.33	.56	.65	.43	1.64	1.50	3.55	4.41	1.66	9.62	8.00	7.96	7.00	5.52	5.00
181, 244, 461, 753, 787	12.19	.76	.74	.51	2.01	2.00	5.49	3.97	2.30	11.76	10.00	9.46	9.00	6.18	5.00

⊕Water insoluble organic nitrogen, less than 50 .00% active indicating that some low grade organic nitrogen was used in the fertilizer.

†Total potash associated with organic matter, valued at 5 cents per pound.

*No. 427-644-666-852-937	Chlorine .82%	equivalent to	1.07%	potash, 8.38%	potash as sulfate.
" 414-674-854-954	" .72%	"	.94%	" 10.29%	" "
" 997	" .47%	"	.62%	" 10.95%	" "
" 991	" .64%	"	.84%	" 5.80%	" "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Rogers & Hubbard Co. (Continued.)				
Hubbard's Bone Base New Mark't Gar. Phosphate	Hadley	$36.00		
" " " " " " "	N. Westport	38.00		
" " " " " " "	E. Milton	37.00		
" " " " " " "	W. Peabody	40.00	$23.54	59.30
" " " " " " "	Upton	37.00		
" " " " " " "	N. Hanover	37.00		
Hubbard's Bone Base Sal. Corn & Gen. Crops Man.	Hadley	39.00		
" " " " " " " " "	Whitman	40.00		
" " " " " " " " "	W. Peabody	40.00	23.91	66.46
" " " " " " " " "	Upton	40.00		
" " " " " " " " "	N. Hanover	40.00		
Hubbard's Bone Base Soluble Potato Manure	N. Hadley	40.00		
" " " " " "	Hadley	45.00	31.53	36.38
" " " " " "	N. Westport	44.00		
Hubbard's Bone Base Soluble Tobacco Manure	Hadley	47.00	36.43	29.02
Hubbard's Bone Base Soluble Tobacco Manure	Hadley	50.00	34.84	43.52
" " " " " "	N. Westport	50.00		
Hubbard's Bone Base Fruit Grass & Grain Fert.	Hadley	45.00		
" " " " " " "	E. Milton	45.00	29.33	55.13
" " " " " " "	W. Peabody	46.00		
" " " " " " "	Upton	46.00		
Hubbard's Bone Base Oats and Top Dressing	Hadley	57.00		
" " " " " " "	N. Westport	58.00	43.07	32.92
" " " " " " "	Seekonk	57.00		
" " " " " " "	Chelmsford	57.00		
Ross Bros. Co., 88-92 Front St., Worcester, Mass.				
Potato and Vegetable Fertilizer	Worcester	34.00	19.19	77.18
Corn, Grain and Grass Fertilizer	Worcester	37.00	25.91	42.80
Lawn and Garden Fertilizer	Worcester	35.00	20.77	68.52
High Grade Potato Fertilizer	Worcester	40.00	27.97	33.18
" " " "	Littleton	34.50		
N. Roy & Son, South Attleboro, Mass.				
Roy's Animal Fertilizer	Man'f't'r's sample	—	32.85	—
Sanderson Fertilizer & Chemical Co., New Haven, Ct.				
Sanderson's Formula "A"	Sunderland	34.00	23.64	43.83
Sanderson's Formula "A"	Sunderland	32.30	25.93	24.57
Sanderson's Formula "A"	Sunderland	34.00	28.72	18.39
Sanderson's Formula "A"	Sunderland	32.30	23.29	38.04
" " "	Bradstreet	32.00		
Sanderson's Formula "B"	Sunderland	32.30		
" " "	Sunderland	34.00	27.04	23.63
" " "	Sunderland	34.00		
Sanderson's Formula "B"	Southwick	33.00		
" " "	Sunderland	33.00	25.17	30.43
" " "	Feeding Hills	32.50		
Sanderson's Top Dressing for Grass and Grain	Sunderland	34.25	26.74	31.38
" " " " " " "	Sunderland	36.00		
Sanderson's Potato Manure	G. Barrington	30.00	18.28	64.12
" " "	Woronoco	30.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
184, 235, 468, 522, 737, 796	8.27	.65	1.01	.46	2.12	2.00	2.68	4.31	1.61	8.60	7.00	6.99	6.00	10.68	10.00
183, 474, 528, 761, 792	7.57	.88	1.18	.55	2.61	2.50	2.19	5.07	2.90	10.16	8.00	7.26	6.00	8.21	8.00
140, 193, 278	9.33	1.78	2.54	.71	5.03	5.00	.80	6.09	4.54	11.43	10.00	6.89	7.00	5.57*	5.00
14	8.11	1.93	2.40	.75	5.08	5.00	.74	5.87	4.64	11.25	10.00	6.61	7.00	10.55*	10.00
191, 251	11.51	2.02	2.11	.68	4.81	5.00	.61	6.84	3.93	11.38	10.00	7.45	7.00	9.76*	10.00
182, 446, 520, 748	9.22	.46	1.34	.62	2.42	2.20	trace	8.10	7.20	15.30	16.00	8.10	6.50	12.54	12.00
186, 231, 271, 545	5.78	4.81	2.63	.82	8.26	8.50	trace	5.41	2.68	8.09	8.00	5.41	4.50	9.98	3.00
749	14.21	.78	.68	.41	1.87	1.65	5.91	2.79	.66	9.36	8.50	3.70	8.00	5.32	5.00
908	14.21	1.20	.88	.60	2.68	2.88	4.69	2.99	1.04	8.72	8.50	7.68	8.00	10.73	8.00
767	9.38	1.50	.65	.51⊕	2.66	2.00	1.89	3.96	3.21	9.06	10.00	5.85	6.00	6.09	4.00
743, 836	12.52	.70	1.62	.76	3.08	2.38	6.31	2.11	.38	8.80	8.50	8.42	8.00	9.46*	10.00
744	7.60	.75	1.85	.85	3.45	4.00	.38	11.89	4.67	16.94	15.00	12.27	—	8.60*	3.00
52	6.44	1.18	1.54	.50	3.22	3.30	5.36	1.50	2.07	8.93	9.00	6.86	6.00	5.71	6.00
67	10.45	.90	2.04	.66	3.60	3.30	5.36	2.12	.89	8.37	9.00	7.48	6.00	6.32	6.00
89	11.05	2.48	1.27	.57	4.32	3.30	5.29	2.37	1.58	9.24	9.00	7.66	6.00	7.21	6.00
349, 423	9.19	1.28	1.48	.46	3.22	3.30	5.26	1.14	1.94	8.34	9.00	6.40	6.00	5.89	6.00
143, 199, 338	8.30	1.93	1.21	.52	3.66	3.33	5.74	1.43	1.58	8.75	10.00	7.17	6.00	7.09*	6.00
479, 579, 975	11.53	1.54	1.28	.66	3.48	3.33	4.53	2.92	1.33	8.78	10.00	7.45	6.00	5.66*	6.00
147, 336	7.69	3.10	.67	.26	4.03	4.00	5.61	1.53	1.61	8.75	—	7.14	7.00	7.28	7.00
1013, 1027	8.66	.57	.91	.40	1.88	1.67	3.35	2.72	1.76	7.83	8.00	6.07	5.00	6.26	6.00

*No. 140-193-278 Chlorine .73% equivalent to .97% potash, 4.60% potash as sulfate.
" 14 " .66% " .87% " 9.68% " "
" 191-251 " .64% " .84% " 8.92% " "
" 743-836 " 3.88% " 5.15% " 4.31% " "
" 744 " 3.36% " 4.48% " 4.12% " "
" 143-199-338 " .45% " .60% " 6.49% " "
" 479-579-975 " .64% " .85% " 4.81% " "

⊕*Water insoluble* organic nitrogen less than 50.00% active, indicating that some low grade organic nitrogen was used in the fertilizer.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Sanderson's Fertilizer & Chem. Co., (Continued.)				
Sanderson's Special with 10% Potash	N. Amherst	$33.50	$27.03	23.94
Sanderson's Special with 10% Potash	Feeding Hills	34.00	23.85	44.65
" " " " "	G. Barrington	35.00		
Sanderson's Corn Superphosphate	Woronoco	28.00	16.45	70.21
Atlantic Coast Bone, Fish and Potash	Dighton	25.00	16.54	51.15
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
Swift-Sure Superphosphate for General Use	Sunderland	33.00	28.52	15.71
Swift-Sure Superphosphate	Hatfield	35.00	24.87	38.72
" " "	W. Springfield	34.00		
Swift-Sure Superphosphate for Potatoes	Sunderland	33.50	25.82	29.75
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston,				
Swift's Lowell Bone Fertilizer, Corn and Grain	Millis	28.00	18.11	61.51
" " " " " " "	Ayer	28.00		
" " " " " " "	W. Acton	33.00		
" " " " " " "	Holyoke	28.00		
Swift's Lowell Potato Phosphate	Sunderland	34.00	21.87	53.18
" " " "	Raynham	33.00		
Swift's Lowell Potato Phosphate	Ayer	33.00	22.63	45.82
Swift's Lowell Animal Brand	Sunderland	30.00	20.31	47.71
Swift's Lowell Animal Brand	Sunderland	30.00	21.03	50.26
" " " "	Sunderland	30.00		
" " " "	Sunderland	30.00		
" " " "	Raynham	32.00		
" " " "	Sunderland	—		
" " " "	Northboro	36.00		
Swift's Market Garden Manure	Taunton	37.50	26.19	47.02
" " " "	Beverly	40.00		
" " " "	Ayer	38.00		
Swift's Lowell Potato Manure	Millis	28.00	16.75	83.11
" " " "	Ayer	30.00		
" " " "	Northbridge	34.00		
Swift's Lowell Lawn Dressing	Concord	45.00	24.90	80.73
" " " "	Upton	45.00		
Swift's Special Grass Mixture	Sunderland	38.50	25.25	52.48
Swift's Potato Grower	Amesbury	38.00	26.55	43.13
" " "	Ayer	38.00		
Swift's Lowell Dissolved Bone and Potash	Millis	27.00	16.77	61.00
Swift's Lowell Empress Brand	Southwick	28.00	14.33	86.67
" " " "	Milford	24.00		
" " " "	Northbridge	28.00		
" " " "	Sterling	27.00		
Swift's Sterling Phosphate	Sterling	28.00	15.63	79.14
Swift's Lowell Perfect Tobacco Grower	Sunderland	36.00	24.45	47.24
Swift's Lowell Seeding Down Fertilizer	Marblehead	35.00	22.16	57.94
Swift's Special Potato Fertilizer	Sunderland	37.00	24.34	52.01
" " " "	Raynham	37.00		
Swift's Superior Fert. with 10% Potash	Seekonk	38.00	28.85	37.78
" " " " " "	Taunton	41.00		
" " " " " "	Beverly	42.00		
" " " " " "	Ayer	38.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Nitrogen: Active Organic.	Nitrogen: Inactive Organic.	Nitrogen: Total. Found.	Nitrogen: Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total. Found.	Phosphoric Acid: Total. Guaranteed.	Phosphoric Acid: Available. Found.	Phosphoric Acid: Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash: Guaranteed.
7	6.45	1.51	1.21	.40	3.12	2.47	4.97	1.48	.97	7.42	8.00	6.45	6.00	11.43	10.00
973, 1003	10.33	.86	1.12	.48	2.46	2.47	.38	4.75	2.04	7.17	8.00	5.13	6.00	10.46*	10.00
1037	12.28	.19	1.16	.59	1.94	1.67	1.28	5.38	2.88	9.54	9.00	6.66	7.00	2.64	2.00
328	13.87	.78	.84	.46	2.08	1.67	.92	3.64	1.56	6.02	6.00	4.46	4.00	5.37	4.00
124	9.03	1.07	1.60	.48	3.16	2.88	7.50	3.04	1.20	11.74	12.00	10.54	9.00	5.62*	4.50
212, 933	11.43	.76	1.50	.61	2.87	2.88	6.83	2.76	1.43	11.02	12.00	9.59	9.00	5.17*	4.50
162	12.39	.74	1.39	.71	2.84	2.88	6.38	3.07	.48	9.93	11.00	9.45	8.00	7.83	7.00
403, 660, 832, 971	11.04	.11	1.29	.46	1.86	1.64	6.67	1.85	1.91	10.43	9.00	8.52	8.00	2.97	3.00
134, 357	7.90	1.06	1.06	.34	2.46	2.46	6.72	1.80	.23	8.75	9.00	8.52	8.00	6.24	6.00
650	11.14	.71	1.27	.65	2.63	2.46	5.91	2.43	.46	8.80	9.00	8.34	8.00	6.16	6.00
88	8.59	.78	1.34	.43	2.55	2.46	5.36	2.86	.56	8.78	9.00	8.22	8.00	4.00	4.00
161, 194, 345, 369, 577, 727	11.01	.81	1.30	.53	2.64	2.46	5.59	2.35	1.12	9.06	9.00	7.94	8.00	4.42	4.00
332, 491, 647	9.09	1.64	1.63	.65	3.92	4.10	5.23	2.27	.56	8.06	8.00	7.50	7.00	5.97	6.00
407, 678, 726	9.69	.27	.97	.53	1.77	1.64	4.06	2.79	.99	7.84	8.00	6.85	7.00	4.25	4.00
524, 762	5.24	3.47	.21	.24⊕	3.92	4.00	6.10	1.99	.20	8.29	8.00	8.09	7.00	5.69	6.00
145	6.65	2.18	1.24	.42	3.84	4.10	5.80	1.42	.66	7.88	8.00	7.22	7.00	5.89	6.00
691, 672	8.24	1.05	1.63	.56	3.24	3.28	4.63	2.15	.36	7.14	7.00	6.78	6.00	9.88	10.00
388	9.37	.14	.97	.60	1.71	1.64	5.27	3.66	1.58	10.51	10.00	8.93	9.00	2.05	2.00
600, 707, 733, 828	7.80	.14	.96	.43	1.53	1.25	3.48	3.69	1.02	8.19	8.00	7.17	7.00	2.15	2.00
826	8.87	.16	.51	.42⊕	1.09	.82	5.36	2.78	2.37	10.51	9.00	8.14	8.00	4.01	4.00
146	6.37	2.21	1.02	.50	3.73	4.10	4.46	.95	.18	5.69	5.00	5.41	4.00	6.47†	6.00
798	10.27	.83	1.07	.53	2.48	2.48	6.89	2.04	.10	9.03	9.00	8.93	8.00	5.97	6.00
133, 341	7.30	1.17	1.07	.33	2.57	2.46	5.36	1.38	.28	7.02	7.00	6.74	6.00	10.55	10.00
307, 326, 490, 677	9.37	1.54	1.44	.70	3.68	3.69	5.91	1.79	.46	8.16	8.00	7.70	7.00	9.92	10.00

*No. 973–1003 Chlorine 3.64% equivalent to 4.83% potash, 5.63% potash as sulfate.
" 124 " .15% " .20% " 5.42% " "
" 212–933 " .49% " .67% " 4.50% " "

⊕*Water insoluble* organic nitrogen less than 50.00% active, indicating that some low grade organic nitrogen was used in the fertilizer.

†Potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Swift's Lowell Fertilizer Co., (Continued.)				
Swift's Special Corn and Vegetable Manure	Seekonk	$34.00	$25.74	37.92
“ “ “ “ “ “	Amesbury	37.00		
Swift's Cereal Brand Fertilizer	Southwick	26.00	11.87	119.03
20th Century Specialty Co., Boston, Mass.				
Ready Complete 12L	Man'f't'r's sample	—	17.21	—
Wm. Thomson & Sons, Ltd., Clovensford, Scotland.				
Improved Vine, Plant and Vegetable Manure	Boston	**	28.51	—
Chrysanthemum Manure	Boston	**	30.88	—
Whitman & Pratt Rend. Co., Lowell, Mass.				
Whitman & Pratt's Corn Success	Woburn	27.00	19.84	43.65
“ “ “ “	Pepperell	30.00		
Whitman & Pratt's All Crops	Woburn	32.00	23.34	32.82
“ “ “ “	Pepperell	30.00		
Whitman & Pratt's Potato Plowman	N. Chelmsford	40.00	27.39	46.04
Whitman & Pratt's Vegetable Grower	Concord	32.00		
“ “ “ “	Concord Jct.	32.00	26.93	24.88
“ “ “ “	Concord	34.00		
“ “ “ “	Concord Jct.	36.50		
Wilcox Fertilizer Co., Mystic, Conn.				
Wilcox Potato, Onion and Vegetable Phosphate	Amherst	35.00		
“ “ “ “ “ “	New Bedford	36.00	26.88	32.70
“ “ “ “ “ “	Fall River	36.00		
Wilcox Grass Fertilizer	Fall River	37.50	27.74	34.29
“ “ “	Seekonk	37.00		
Wilcox High Grade Tobacco Special	Amherst	37.00	28.21	31.16
Wilcox Complete Bone Superphosphate	Fall River	30.00	19.14	61.96
“ “ “ “	Marblehead	32.00		
Wilcox Potato Fertilizer	Amherst	30.00	18.67	60.69
“ “ “	Fall River	30.00		
Wilcox Fish and Potash	Amherst	28.00	17.96	55.90
Wilcox Fish and Potash	New Bedford	30.00	18.42	62.86
Wilcox 4-8-10	Fall River	41.50	29.53	40.53
Wilcox High Grade Fish and Potash	Dighton	31.00	23.96	29.39
Wilcox Special Superphosphate	N. Wilbraham	23.50	16.40	43.29
A. H. Wood & Co., Framingham, Mass.				
Wood's B. B. Fertilizer	Framingham	30.00	22.73	31.98
Wood's S. P. Fertilizer	Framingham	40.00	32.66	22.47
“ “ “	Framingham	40.00		
Wood's 777 Fertilizer	Framingham	45.00	33.10	18.10
“ “ “	Framingham	45.00		

**No. 570 Sold only in small quantities, 56 lb. bags for $7.00.
No. 547 Sold only in small quantities, 112 lb. bags for $7.00.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
314, 602	10.07	1.09	1.52	.62	3.23	3.20	6.38	1.76	1.02	9.16	9.00	8.14	8.00	7.21	7.00
516	7.06	.23	.48	.39	1.10	.82	4.40	2.95	.69	8.04	3.00	7.35	7.00	1.23	1.00
1024	3.33	2.09	.16	.20	2.45	1.00	3.13	1.90	.48	5.51	2.80	5.03	2.40	4.55†	3.00
570	9.34	1.30	1.72	.72	3.74	3.50	5.68	3.75	3.02	12.45	12.00	9.43	8.00	6.11*	7.00
547	2.61	3.70	1.14	.44	5.28	4.00	3.55	3.85	5.94	13.34	12.00	7.40	6.50	4.78	4.50
608, 654	8.05	.21	1.29	.58	2.08	1.64	4.02	3.74	3.06	10.82	10.00	7.76	8.00	4.54	3.00
612, 659	10.13	.97	1.39	.64	3.00	2.46	4.82	3.45	3.64	11.91	11.00	8.27	9.00	4.19	4.00
888	8.29	.88	1.87	.85	3.60	3.50	4.25	3.17	2.02	9.44	9.00	7.42	7.00	7.66	6.00
348, 376, 384, 391	9.28	1.52	1.27	.65	3.44	3.29	5.20	2.96	2.50	10.66	10.00	8.16	8.00	7.46	7.00
142, 294, 302	9.43	1.63	1.26	.61	3.50	3.30	5.23	2.38	1.91	9.52	8.00	7.61	7.00	7.69*	6.00
250, 273	9.98	1.67	1.82	.86	4.35	4.11	2.59	3.67	2.44	8.70	7.00	6.26	6.00	6.02*	5.00
103	8.13	1.29	1.92	.76	3.97	3.30	trace	4.23	5.23	9.46	7.00	4.23	5.00	7.97*	7.00
234, 800	15.93	1.00	.78	.45	2.23	2.05	.93	5.32	5.82	12.07	9.00	6.25	8.00	4.22	3.00
158, 233	15.05	1.11	.67	.39	2.17	2.06	.74	5.38	3.37	9.49	7.00	6.12	6.00	5.37	4.50
135	20.51	.25	1.45	.78	2.48	2.46	.23	4.44	3.75	8.42	6.00	4.67	5.00	3.50	3.00
296	20.18	.22	1.52	.81	2.55	2.46	.13	4.84	3.32	8.29	6.00	4.97	5.00	3.82	3.00
247	9.83	1.38	1.37	.65	3.40	3.30	4.53	3.61	2.32	10.46	9.00	8.14	8.00	10.12*	10.00
1044	20.96	.30	2.09	.96	3.35	3.30	4.06	2.27	1.02	7.35	7.00	6.33	6.00	5.79	5.00
1030	16.06	.27	.74	.48	1.49	1.03	4.18	5.56	1.10	10.84	9.00	9.74	8.00	2.37	2.00
869	8.36	.75	1.37	.66	2.78	2.50	2.04	5.20	3.70	10.94	11.00	7.24	7.00	5.57	5.00
695, 864	6.84	2.95	.60	.40	3.95	4.00	4.34	2.65	.97	7.96	9.00	6.99	6.00	12.85*	12.00
841, 868	7.01	5.12	1.74	.70	7.56	7.00	3.32	2.35	1.35	7.02	9.00	5.67	7.00	7.71	7.00

†Potash as sulfate.

*No. 570	Chlorine, 4.23%	equivalent to 5.63%	potash,	.48%	potash as sulfate.
" 142–294–302	" 4.43%	" 5.89%	"	1.80%	" "
" 250–273	" 2.99%	" 3.96%	"	2.06%	" "
" 103	" .42%	" .55%	"	7.42%	" "
" 247	" 4.97%	" 6.61%	"	3.51%	" "
" 695–864	" .27%	" .36%	"	12.49%	" "

Fertilizers Furnishing Phosphoric Acid and Potash.

Name of Manufacturer and Brand	Where Sampled	Dealer's Cash Price per Ton	Comparative Valuation per Ton	Percentage Difference Between Selling Price and Valuation.
PHOSPHATE AND POTASH				
[illegible]				
[illegible]	[illegible]		[illegible]	—
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WOOD ASHES				
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]	[illegible]	—	[illegible]	—

[illegible]

Fertilizers Furnishing Phosphoric Acid and Potash

Laboratory Number	Moisture	Phosphoric Acid in 100 lbs.: Water Soluble	Reverted	Insoluble	Total: Found	Total: Guaranteed	Available: Found	Available: Guaranteed	Potash (K_2O) in 100 lbs.: Found	Potash: Guaranteed	[illegible] in 100 lbs.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	—	—	—	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	—	—	—	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	—	—	—	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	—	—	—	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]
[illegible]	none	—	—	—	[illegible]	—	—	—	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	—	—	—	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]

Fertilizers for Private Use, Officially Collected (Not Licensed.)

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works, Baltimore, Md.				
Martin's Potato Special	Littleton	$41.00	$36.65	11.87
Berkshire Fertilizer Co., Bridgeport, Conn.				
Fish and Potash	N. Hadley	26.00	18.32	41.92
Hibbard's Special Mixture	N. Hadley	34.00	29.40	15.65
Special Mixture	Amherst	—	31.07	—
Special Mixture	Amherst	22.00	19.45	13.11
Bowker Fertilizer Co., Boston, Mass.				
Special Mixture	W. Hatfield	37.50	31.72	18.03
Coe Mortimer Co., New York City.				
Special Mixture	W. Springfield	36.00	26.75	34.58
Florist Chemical Co., 60 Trinity Pl., New York City.				
Brazilian Plant Food	Clinton	100.00	38.77	157.92
Mitchell Fertilizer Co., Tremley, N. J.				
Mitchell's Vegetable Fertilizer	Seekonk	40.00	25.07	59.55
Mitchell's Special Fertilizer	Seekonk	38.00	29.96	26.84
National Fertilizer Co., Boston, Mass.				
Chittenden's Universal Fertilizer	W. Action	26.50	13.59	95.00
Olds & Whipple, Hartford, Conn.				
Conant's Special Mixture	Sunderland	35.00	28.26	23.85
M. H. Pease, East Longmeadow, Mass.				
Home Mixture for Grass	E. Longmeadow	39.00	37.55	3.86
Patrons' Co-operative Association, Boston, Mass.				
Special Mixture—marked M. H.	Sunderland	33.00	26.18	26.05
Prof. J. W. Sanborn, Pittsfield, N. H.				
Sanborn's Chemical for use in hill, 1911	So. Ashfield	29.00	21.91	32.36
Sanborn's Chemical for Corn and Potatoes	So. Ashfield	35.00	28.78	21.61
Sanderson Fert. & Chem. Co., New Haven, Conn.				
Bronson's Special Formula	Plainfield	—	31.59	—
Cranson's Special Mixture	Buckland	31.00	25.34	22.34
Berkshire Fertilizer Co., Bridgeport, Conn.				
Ground Castor Pomace	Sunderland	27.00	21.38	26.29
H. G. Sulfate of Potash	N. Hadley	50.40	49.80	1.20
Dry Ground Fish	Sunderland	44.00	40.62	8.35
Dry Ground Fish	N. Hadley	45.00	39.80	13.07
Dry Ground Fish	N. Hadley	44.00	40.14	9.62
Muriate of Potash	N. Hadley	42.40	44.00	‡3.64
A. W. Dodd & Co., Gloucester, Mass.				
Fish	N. Beverly	35.00	42.70	‡18.03
Edmun Mortimer, Grafton, Mass.				
Nitrate of Potash	W. Springfield	92.00	83.94**	9.60
Olds & Whipple, Hartford, Conn.				
Dried Blood	Hockanum	58.00	60.90	‡ 4.76
Ross Bros., Worcester, Mass.				
Nitrate of Soda	W. Springfield	45.00	47.30	‡ 4.86
Berkshire Fertilizer Co., Bridgeport, Conn.				
Tankage	N. Hadley	42.40	39.81	6.51
Tankage	Sunderland	42.40	39.36	7.72
Russell Cutlery Co., Turners Falls, Mass.				
Bone Dust	Montague	20.00	34.76	‡42.46

‡Valuation in excess of selling price.
**The potash in nitrate of potash is valued at 5 cts. per pound.

Fertilizers for Private Use, Officially Collected (Not Licensed.)

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash K(2O) in 100 lbs. Found.	Guaranteed.
835	5.83	2.51	1.57	.70	4.78	4.11	7.18	2.26	.87	10.31	9.50	9.44	9.00	11.10*	10.00
334	10.70	.14	1.64	.92	2.70	2.50	.36	4.47	1.68	6.51	6.00	4.83	—	3.60	3.00
94	8.00	2.25	1.17	.69	4.11	3.80	5.71	2.61	.56	8.88	—	6.32	8.00	7.57*	8.00
670	5.92	1.52	1.78	.89⊕	4.19	3.80	5.74	2.66	.71	9.11	—	8.40	8.00	8.12*	8.00
775	10.79	.02	—	—	.15	—	9.35	1.60	.10	11.05	—	10.95	10.00	10.73	10.00
598	6.98	.23	3.36	1.56	5.15	—	.04	4.17	2.14	6.35	—	4.21	—	7.18*	—
922	7.21	1.72	1.26	.54	3.52	3.29	3.42	5.22	.72	9.36	—	8.64	8.00	6.50†	8.00
875	7.77	1.01	3.87	1.59	6.47	—	.61	10.87	.16	11.64	—	11.48	—	4.39†	—
563	13.80	.99	1.63	.63	3.25	3.29	6.28	1.88	1.05	9.21	9.00	8.16	8.00	6.22	6.00
269	11.63	1.11	2.13	.79	4.03	4.11	3.38	4.58	1.73	9.69	9.00	7.96	8.00	8.64	8.00
880	10.59	.24	.48	.26	.98	.82	5.27	2.92	1.94	10.13	9.00	8.19	8.00	2.35	1.00
76	9.90	.51	1.91	.91	3.33	—	.89	8.60	.82	10.31	—	9.49	—	8.63	—
1033	6.16	2.45	2.63	.75	5.83	—	5.04	.38	.36	6.28	—	5.92	—	10.85*	—
578	9.94	1.40	1.22	.85	3.47	3.80	3.32	3.11	1.91	8.34	8.00	6.43	—	8.45	7.00
995	11.95	1.16	.94	.51	2.61	2.50	4.59	3.81	3.62	12.02	12.00	8.40	7.00	4.44	4.00
998	11.39	1.05	1.81	.60	3.46	3.50	6.22	2.83	1.79	10.84	10.00	9.05	7.00	8.07*	8.00
999	10.25	3.21	1.22	.47	4.90	—	4.57	1.43	.48	6.48	—	6.00	—	9.61*	—
1000	18.16	1.18	1.62	.61	3.41	—	4.38	2.41	1.20	7.99	—	6.79	—	7.04*	—
51	8.86	—	2.97	2.22	5.09	4.50	—	—	—	—	—	—	—	—	—
109	.73	—	—	—	—	—	—	—	—	—	—	—	—	49.80	49.00
53	6.77	—	—	—	7.84	7.40	—	4.34	2.73	7.07	6.00	4.34	—	—	—
70	7.27	—	5.66	1.91	7.67	7.40	—	5.07	2.30	7.37	6.00	5.07	—	—	—
178	8.13	—	—	—	7.71	7.40	—	4.74	2.20	6.94	6.00	4.74	—	—	—
79	1.68	—	—	—	—	—	—	—	—	—	—	—	—	51.76	50.54
489	8.82	—	5.33	1.74	7.07	—	—	9.88	5.71	15.59	—	9.88	—	—	—
921	2.58	12.08	—	—	12.08	14.00	—	—	—	—	—	—	—	45.28	44.00
320	12.18	—	—	—	13.24	—	—	—	—	—	—	—	—	Mechanical Analysis	
958	2.03	14.78	—	—	14.78	—	—	—	—	—	—	—	—	Fine Bone	Coarse Bone
69	8.50	—	5.97	2.03	8.00	7.40	—	—	—	12.76	10.00	—	—	74.09	25.91
106	7.74	—	6.00	1.60	7.60	7.40	—	—	—	13.50	10.00	—	—	79.49	20.51
1011	9.21	—	—	—	3.70	—	—	—	—	26.30	—	—	—	83.06	16.94

*No. 835 Chlorine .93% equivalent to 1.23% potash, 9.87% potash as sulfate.
" 94 " 1.31% " 1.74% " 5.83% " "
" 670 " .85% " 1.13% " 6.99% " "
" 598 " .62% " .80% " 6.38% " "
" 1033 " .22% " .29% " 10.56% " "
" 998 " 4.35% " 5.77% " 2.30% " "
" 999 " 2.47% " 3.27% " 6.34% " "
" 1000 " 3.76% " 4.99% " 2.05% " "

†Potash as sulfate.

⊕Water Insoluble organic nitrogen less than 50.00% active, indicating that some low grade organic nitrogen was used in the fertilizer.

Ground Bone.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co., Boston, Mass.				
Fine Ground Bone	Amherst	$23.00	$29.29	‡4.40
Fine Dry Ground Bone	New Bedford	30.00	28.41	12.64
" " " "	Middleboro	34.00		
Farquhar's Pure Ground Bone	Boston	33.00	27.94	18.11
Armour Fertilizer Works, Baltimore, Md.				
Raw Bone Meal	Amherst	—	30.85	—
Bone Meal	Marblehead	29.00	26.54	9.27
Atlantic Fertilizer Co., Baltimore, Md.				
Rawson & Hodges Fine Ground Bone	Beverly	30.00	25.58	17.28
Beach Soap Co., Lawrence, Mass.				
Fertilizer Bone	Lawrence	30.00	26.36	13.81
Bowker Fertilizer Co., Boston, Mass.				
Fresh Ground Bone	Beverly	32.00	27.15	14.18
" " "	Milford	30.00		
Buffalo Fertilizer Co., Buffalo, N. Y.				
Bone Meal	Webster	32.00	26.64	20.05
John C. Dow Co., Boston, Mass.				
Dow's Pure Ground Bone	Boston	32.00	27.73	15.40
Thos. Hersom & Co., New Bedford, Mass.				
Bone Meal	New Bedford	28.00	30.10	‡6.98
Home Soap Co., Worcester, Mass.				
Pure Ground Bone	Worcester	31.00	28.34	9.39
Geo. E. Marsh Co., Lynn, Mass.				
Marsh's Pure Bone Meal	Concord	32.00	29.74	5.88
" " " "	Salem	31.00		
D. M. Moulton, Monson, Mass.				
Ground Bone	Manf't'r's sample	—	25.55	—
National Fertilizer Co., Boston, Mass.				
Chittenden's Ground Bone	Leominster	31.00	23.45	3.96
Olds & Whipple, Hartford, Conn.				
Pure Bone Meal	Man'f't'r's sample	—	26.63	—
Rogers Mfg. Co., Rockfall, Conn.				
Pure Knuckle Bone Meal	Fitchburg	37.00	32.12	19.36
" " " "	Greenfield	40.00		
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's Bone Base Pure Raw Knuckle B. Flour	Hadley	40.00	33.35	19.94
" " " " " " " "	E. Milton	40.00		
Hubbard's Bone Base Strictly Pure Fine Bone	Man'f't'r's sample	—	30.47	—
Sanderson Fertilizer & Chemical Co., New Haven, Ct.				
Sanderson's Fine Ground Bone	Sunderland	30.00	27.85	7.72
Sanderson's Fine Ground Bone	Southwick	30.40	24.95	21.84
" " " "	Sunderland	—		
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
Swift-Sure Bone Meal	Sunderland	34.00	39.09	‡13.02
Swift-Sure Bone Meal	Sunderland	34.00	38.85	‡12.48
Springfield Rendering Co., Springfield, Mass.				
Ground Steamed Bone	N. Amherst	31.40	32.15	‡2.33
Ground Steamed Bone	Springfield	30.00	30.11	‡.36
Raw Bone Meal	Springfield	40.00	32.92	21.51

‡Valuation in excess of selling price.

Ground Bone.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
		As Nitrates and Ammoniates.	Active Organic	Inactive Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
84	6.99	—	—	—	2.75	2.47	—	—	—	24.01	22.83	—	—	82.22	17.78
303 396	7.50	—	—	—	2.86	2.47	—	—	—	22.37	22.83	—	—	81.87	18.13
531	10.05	—	—	—	2.91	2.47	—	—	—	22.20	22.80	—	—	71.65	28.35
100	7.14	—	—	—	4.00	3.70	—	—	—	20.84	22.00	—	—	70.05	29.95
625	4.29	—	—	—	1.70	2.47	—	—	—	27.52	22.50	—	—	48.87	51.13
436	10.61	—	—	—	1.24	2.47	—	—	—	28.33	23.00	—	—	49.73	50.27
504	7.72	—	—	—	3.11	3.00	—	—	—	22.63	20.00	—	—	19.14	80.86
493 690	8.34	—	—	—	2.53	2.47	—	—	—	22.63	22.33	—	—	77.71	22.29
859	6.99	—	1.75	.72	2.47	2.90	—	—	—	22.96	22.00	—	—	66.35	33.65
543	6.34	—	—	—	2.19	2.00	—	—	—	25.69	24.00	—	—	66.77	33.23
239	3.93	—	—	—	2.22	2.22	—	—	—	27.48	23.54	—	—	84.61	15.39
813	4.59	—	—	—	3.13	2.00	—	—	—	23.73	28.00	—	—	42.69	57.31
333 363	4.37	—	—	—	2.68	2.46	—	—	—	26.12	28.00	—	—	64.34	35.66
1042	7.25	—	—	—	4.26	4.26	—	—	—	17.37	18.00	—	—	10.01	89.99
638	4.92	—	—	—	3.02	2.47	—	—	—	22.65	22.88	—	—	66.95	33.05
1039	8.83	—	—	—	2.08	2.50	—	—	—	23.93	22.00	—	—	81.52	18.43
657 895	10.28	—	—	—	3.71	3.80	—	—	—	25.72	24.00	—	—	47.59	52.41
139 470	9.76	—	—	—	3.92	3.82	—	—	—	25.26	24.70	—	—	60.72	39.28
981	9.00	—	—	—	3.76	2.35	—	—	—	22.43	22.00	—	—	68.06	41.94
73	5.49	—	—	—	3.01	2.47	—	—	—	21.31	20.00	—	—	68.51	31.49
513 576	6.80	—	—	—	2.33	2.47	—	—	—	22.12	20.00	—	—	54.36	45.64
55	2.91	—	—	—	5.53	4.53	—	—	—	22.31	20.00	—	—	83.35	16.15
127	3.64	—	—	—	5.56	4.53	—	—	—	22.07	20.00	—	—	86.44	13.56
4	5.25	—	—	—	2.97	2.46	—	—	—	25.51	23.00	—	—	97.59	2.41
967	3.52	—	—	—	2.57	2.47	—	—	—	26.00	25.00	—	—	81.15	13.35
976	5.56	—	—	—	3.91	3.00	—	—	—	24.22	25.00	—	—	67.01	32.99

Ground Bone, Dissolved Bone and Tankage.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
T. L. Stetson, Randolph, Mass.				
Pure Ground Bone	Man'f's samp.	—	$28.20	13.48
" " "	Brockton	$33.00		
Swift's Lowell Fertilizer Co., Boston, Mass.				
Ground Bone	Fall River	31.00	30.16	4.44
" "	Worcester	32.00		
A. L. Warren, Northboro, Mass.				
Pure Ground Bone	Man'f's samp.	—	29.78	.74
" " "	Northboro	30.00		
Whitman & Pratt Rend. Co., Lowell, Mass.				
Ground Bone	Woburn	35.00	29.10	20.28
Wilcox Fertilizer Co., Mystic, Conn.				
Pure Ground Bone	New Bedford	30.00	29.62	1.62
" " "	Westfield	30.20		
Sanford Winter Co., Brockton, Mass.				
Pure Ground Bone	Man'f's samp.	—	34.52	‡ 7.30
" " "	Brockton	32.00		
" " "	Man'f's samp.	—		
DISSOLVED BONE.				
W. H. Abbott, Holyoke, Mass.				
Abbott's Animal Fertilizer	N. Hadley	27.00	25.93	4.13
" " "	Sunderland	27.00		
Abbott's Animal Fertilizer	Whately	27.00	28.10	‡ 3.91
Mapes' Form. & Peruv. Guano Co., New York City.				
Mapes' Dissolved Bone	Conway	34.00	24.19	40.55
TANKAGE.				
American Agricultural Chem. Co., Boston, Mass.				
Tankage	Amherst	32.00	34.23	‡ 6.52
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Ground Tankage	Northampton	31.50	28.04	13.23
" " "	N. Abington	32.00		
Coe-Mortimer Co., New York City.				
Tankage	Attleboro	35.00	23.20	50.86
Thos. Hersom & Co., New Bedford, Mass.				
Meat and Bone	New Bedford	28.00	32.97	‡15.07
Lister's Agricultural Chem. Works, Newark, N. J.				
Tankage	Hockanum	46.00	30.81	28.21
"	Hadley	33.00		
Geo. E. Marsh Co., Lynn, Mass.				
Ground Tankage	Concord	33.00	29.68	11.19
Olds & Whipple, Hartford, Conn.				
Tankage	N. Hadley	36.00	38.54	‡ 6.59
Sanderson Fert. & Chem. Co., New Haven, Conn.				
Blood, Bone and Meat	Bradstreet	36.00	31.01	16.09
" " " "	Southwick	36.00		
Springfield Rend. Co., Springfield, Mass.				
Ground Tankage	Amherst	36.40	40.87	‡10.94
Dry Ground Tankage	Southampton	30.00	33.40	‡10.18
Ground Tankage	Springfield	35.00	33.25	6.77
" "	Westfield	36.00		

‡Valuation in excess of selling price.

Ground Bone, Dissolved Bone and Tankage.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.		Fine Bone.	Coarse Bone.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
731 784	11.06	—	—	—	4.22	4.20	—	—	—	20.89	20.66	—	—	14.63	35.37
245 886	4.59	—	—	—	2.93	2.46	—	—	—	24.80	23.00	—	—	74.15	25.85
855 857	6.97	—	—	—	2.84	2.00	—	—	—	24.01	22.78	—	—	85.02	14.98
592	6.84	—	—	—	2.55	2.47	—	—	—	26.61	25.00	—	—	54.15	45.85
233 1032	8.82	—	—	—	3.05	2.46	—	—	—	24.31	22.00	—	—	62.93	37.07
439 467 963	9.50	—	—	—	6.17	3.08	—	—	—	17.40	25.08	—	—	48.48	51.52
113 123	10.35	.74	2.09	1.10	3.93	3.00	1.12	9.04	6.40	16.56	15.00	10.16	11.00	—	—
1019	8.87	.56	2.44	1.20	4.20	3.00	1.40	10.58	5.08	17.07	15.00	11.98	11.00	60.15	39.35
913	7.62	.23	1.74	.87	2.84	2.06	6.89	7.75	1.53	16.17	—	14.64	12.00	—	—
119	13.29	—	5.38	1.33	6.71	4.94	—	—	—	14.57	13.73	—	—	47.75	52.25
220 807	8.58	.44	3.45	1.23	5.12	4.94	—	—	—	11.45	13.73	—	—	74.38	25.62
249	10.01	.31	2.11	1.33	3.75	4.96	—	—	—	13.29	13.70	—	—	52.03	47.97
295	5.12	.05	3.21	1.59	4.85	5.00	—	—	—	18.57	17.00	—	—	80.81	19.19
315 992	11.31	.47	4.09	1.17	5.73	4.94	—	—	—	14.80	13.73	—	—	45.22	54.78
324	8.60	.41	3.54	1.89	5.84	5.00	—	—	—	11.33	12.00	—	—	60.61	39.39
990	10.26	.41	6.24	1.95	8.60	—	—	—	—	9.49	9.00	—	—	63.84	36.16
425 499	7.90	.21	4.24	1.42	5.87	5.74	—	—	—	12.32	10.00	—	—	67.32	32.68
5	5.25	—	6.29	1.96	8.25	6.00	—	—	—	11.51	12.00	—	—	85.86	14.14
702	5.47	.11	4.16	1.45	5.72	5.00	—	—	—	15.95	9.00	—	—	69.36	30.64
974 1023	8.39	.26	4.98	1.79	7.03	7.40	—	—	—	11.46	12.00	—	—	50.61	49.39

Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Swift's Lowell Fert. Co., Boston, Mass.				
Ground Tankage	Concord	$30.50	$32.13	‡ 5.07
J. M. Woodard, Greenfield, Mass.				
Unground Tankage	Greenfield	—	30.83	—
Worcester Rendering Co., Worcester, Mass.				
Ground Tankage	Worcester	44.00	36.30	4.63
" "	Sterling	32.00		
DRY GROUND FISH.				
American Agr'l. Chem. Co., Boston, Mass.				
Dry Ground Fish	Bradstreet	40.00	42.39	‡ 5.64
Dry Ground Fish	Sunderland	44.00	44.37	‡ .83
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Dry Ground Fish	Sunderland	42.00	46.42	‡ 9.52
Bowker's Dry Ground Fish	Northampton	40.00		
" " " "	Dighton	46.00	44.55	‡ 4.98
" " " "	Sunderland	41.00		
National Fertilizer Co., Boston, Mass.				
Chittenden's Dry Ground Fish	Hadley	40.00	42.73	‡6.39
Chittenden's Dry Ground Fish	Bradstreet	40.00	41.31	‡3.17
Chittenden's Dry Ground Fish	Bradstreet	40.00	43.99	‡9.07
Chittenden's Dry Ground Fish	So. Deerfield	44.00	44.51	‡1.15
Chittenden's Dry Ground Fish	Hadley	40.00		
" " " "	Sunderland	42.00		
" " " "	Sunderland	42.00	42.60	‡2.82
" " " "	N. Hadley	42.00		
" " " "	Sunderland	41.00		
Olds & Whipple, Hartford, Conn.				
O. & W. Dry Ground Fish	N. Hadley	—	42.39	—
O. & W. Dry Ground Fish	N. Hadley	40.00	41.18	‡2.87
O. & W. Dry Ground Fish	Hadley	45.00	42.61	5.61
Robinson Glue Co., Gloucester, Mass.				
Dry Ground Fish	Worcester	50.00	46.45	7.64
Roger's Mfg. Co., Rockfall, Conn.				
Dry Ground Fish	Deerfield	43.00	42.19	1.92
Sanderson's Fert. & Chem. Co., New Haven, Conn.				
Sanderson's Fine Ground Fish	Sunderland	41.35	41.42	1.13
Sanderson's Fine Ground Fish	Southwick	43.00		
" " " "	Sunderland	—	42.24	‡1.75
" " " "	Feeding Hills	40.00		
Wilcox Fertilizer Co., Mystic, Conn.				
Wilcox Dry Ground Fish Guano	Amherst	45.00		
" " " " "	N. Hadley	—	45.10	‡ .22
Wilcox Dry Ground Acidulated Fish	Fall River	—	39.99	—

‡Valuation in excess of selling price.

Tankage and Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
		As Nitrates and Ammoniates.	Active Organic.	Inactive Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.		Fine Bone.	Course Bone.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
372	9.81	.22	3.97	1.30	5.49	5.00	—	—	—	16.10	14.00	—	—	61.70	38.30
899	7.61	.23	3.69	1.34	5.26	4.50	—	—	—	18.04	18.00	—	—	34.22	65.78
771, 822	8.89	.24	5.76	1.87	7.87	7.00	—	—	—	12.02	12.00	—	—	47.12	52.88
38	10.05	—	5.87	2.39	8.26	8.24	—	4.18	2.63	6.81	7.00	4.18	—	—	—
107	11.22	—	—	—	8.62	8.23	—	4.97	1.84	6.81	7.00	4.97	—	—	—
71	9.39	—	—	—	9.04	8.23	—	5.10	1.89	6.99	6.00	5.10	—	—	—
213, 261, 709	9.83	—	—	—	8.55	8.23	—	4.98	3.11	8.09	6.00	4.98	—	—	—
3	9.35	—	—	—	8.32	8.23	—	4.18	2.81	6.99	6.00	4.18	—	—	—
10	10.37	—	—	—	8.07	8.23	—	3.93	2.63	6.56	6.00	3.93	—	—	—
11	9.95	—	—	—	8.56	8.23	—	4.84	1.84	6.68	6.00	4.84	—	—	—
47	8.79	—	—	—	8.68	8.23	—	4.24	2.98	7.22	6.00	4.24	—	—	—
185, 198, 453, 571, 716	11.13	—	—	—	8.25	8.23	—	4.66	2.30	6.96	6.00	4.66	—	—	—
93	9.71	—	—	—	8.14	7.40	—	5.36	1.66	7.02	6.00	5.36	4.50	—	—
137	9.40	—	—	—	7.94	7.40	—	4.80	2.04	6.84	6.00	4.80	4.50	—	—
428	8.90	—	—	—	8.26	7.40	.19	4.35	2.40	6.94	6.00	4.54	4.50	—	—
764	9.66	—	—	—	8.07	—	—	8.98	5.38	14.36	—	8.98	—	—	—
915	12.60	—	—	—	8.13	7.81	—	5.46	1.05	6.51	6.00	5.46	4.00	—	—
86	9.14	—	—	—	8.23	8.23	—	3.04	2.83	5.87	6.00	3.04	—	—	—
481, 572, 979	12.35	—	—	—	8.18	8.23	—	4.59	2.35	6.94	6.00	4.59	—	—	—
121, 173	8.10	—	—	—	9.02	8.50	—	3.31	2.40	5.71	6.00	3.31	4.00	—	—
1047	10.76	—	—	—	7.63	7.81	—	5.82	.58	6.40	6.00	5.82	4.00	—	—

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble.	Organic.	Guaranteed.
SULFATE OF AMMONIA.									
American Agric. Chem. Co., Boston, Mass.									
Sulfate of Ammonia	Boston	$75.00	$67.65	10.37	560	.64	21.14	—	20.16
Bowker Fert. Co., Boston, Mass.									
Sulfate of Ammonia	Boston	68.00	67.90	.15	536	1.16	21.22	—	19.75
Swift's Lowell Fert. Co., Boston, Mass.									
Sulfate of Ammonia	Taunton	66.00	65.60	3.66	361	1.54	20.50	—	20.00
" " "	Woburn	70.00			619				
NITRATE OF SODA.									
American Agric. Chem. Co., Boston, Mass.									
Nitrate of Soda	Sunderland	46.00	49.22	‡6.54	83	1.57	15.38	—	15.00
Nitrate of Soda	New Bedford	53.00	49.09	5.93	309	1.84	15.34	—	15.00
" " "	Boston	51.00			533				
Armour Fert. Works, Baltimore, Md.									
Nitrate of Soda	Billerica	55.00	48.45	12.49	552	1.60	15.14	—	14.31
" " "	Feeding Hills	54.00			980				
Atlantic Fertilizer Co., Baltimore, Md.									
Nitrate of Soda	Millis	—	49.60	—	398	.86	15.50	—	15.82
Bowker Fert. Co., Boston, Mass.									
Nitrate of Soda	Northampton	48.00	48.58	6.51	222	1.70	15.18	—	15.00
" " "	Dighton	52.00			256				
" " "	Taunton	52.00			264				
" " "	Beverly	55.00			493				
Coe-Mortimer Co., New York City.									
Nitrate of Soda	Attleboro	51.00	49.22	2.09	240	1.99	15.38	—	15.00
" " "	W. Springfield	49.50			951				
J. P. Hawes, 88 Broad St., Boston, Mass.									
Nitrate of Soda	Fitchburg	47.00	48.96	‡.94	637	1.89	15.30	—	15.65
" " "	Webster	50.00			892				
German Kali Works, Baltimore, Md.									
Nitrate of Soda	N. Amherst	49.60	49.28	.65	452	2.08	15.40	—	15.00
" " "	Littleton	—			838				
" " "	Man'f sample	—			987				
W. R. Grace & Co., New York City.									
Nitrate of Soda	Framingham	48.00	49.47	‡2.97	723	1.60	15.46	—	15.00
Lister's Agric. Chem. Works, Newark, N. J.									
Nitrate of Soda	Hockanum	53.00	48.19	5.33	321	1.95	15.06	—	15.00
" " "	Leominster	49.00			661				
Mapes' Form. & Peruv. Guano Co., N. Y.									
Nitrate of Soda	Conway	50.00	49.28	1.46	900	1.55	15.40	—	15.00
National Fert. Co., Boston.									
Nitrate of Soda	Bradstreet	48.00	52.22	‡8.08	15	1.80	16.32	—	15.00
Nitrate of Soda	So. Deerfield	50.00	49.31	1.40	48	1.75	15.41	—	15.00
Nitrate of Soda	So. Acton	50.00	49.47	‡3.98	879	.46	15.46	—	15.00
" " "	W. Springfield	45.00			962				
Nitrate Agencies Co., New York City.									
Nitrate of Soda	Sunderland	48.00	49.54	‡3.11	54	.96	15.48	—	15.00
Nitrate of Soda	Amherst	48.00	48.03	‡.06	153	1.50	15.01	—	15.00
" " "	Concord	48.00			373				

‡Valuation in excess of selling price.

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble.	Organic.	Guaranteed.
NITRATE OF SODA. (Concluded.)									
Olds & Whipple, Hartford, Conn.									
Nitrate of Soda	Hockanum	$51.00	$48.19	5.83	316	2.62	15.06	—	15.00
Patrons' Co-Op. Association, Boston, Mass.									
Nitrate of Soda	Marlboro	—	48.06	—	362	1.46	15.02	—	—
Sanderson Fert. & Chem. Co., New Haven.									
Nitrate of Soda	Sunderland	52.00	49.47	5.11	91	1.75	15.46	—	15.00
Nitrate of Soda	Bradstreet	50.00	48.00	3.65	424	2.74	15.00	—	15.00
" " "	Southwick	49.50			515				
" " "	Sunderland	—			540				
Swift's Lowell Fert. Co., Boston, Mass.									
Nitrate of Soda	Taunton	46.00	48.64	‡1.32	378	2.19	15.20	—	15.00
" " "	Beverly	50.00			502				
" " "	Amesbury	48.00			604				
Wilcox Fertilizer Co., Mystic, Conn.									
Nitrate of Soda	Seekonk	47.00	47.04	6.29	285	2.45	14.70	—	15.00
" " "	New Bedford	53.00			290				
DRIED BLOOD.									
Bowker Fert. Co., Boston, Mass.									
Dried Blood	Man. sample	—	51.11	—	*1061	11.08	—	10.55	9.87
Swift's Lowell Fert. Co., Boston, Mass.									
Dried Blood	N. Amherst	51.40	46.89	9.62	* 2	10.96	—	10.07	9.84
Dried Blood	Boston	55.00	48.88	12.52	*567	9.92	—	9.86	9.84
Whitman & Pratt Rend. Co., Lowell, Mass.									
Dried Blood	N. Chelmsford	44.00	49.44	‡11.00	*858	10.60	—	9.76	9.84
CASTOR POMACE.									
Olds & Whipple, Hartford, Conn.									
Castor Pomace	Hatfield	25.00	22.47	11.27	215	11.08	—	5.35	4.98
" "	Bradstreet	25.00			444				
Sanderson Fert. & Chem. Co., New Haven,									
Sanderson's Castor Pomace	Feeding Hills	31.00	24.07	28.79	972	9.78	—	5.73	6.50
Sanderson's Castor Pomace	Whately	30.00	22.89	31.06	1022	10.81	—	5.45	6.50
COTTONSEED MEAL.									
American Cotton Oil Co., New York City.									
Choice Cottonseed Meal	Bradstreet	31.50	29.61	6.38	32	7.53	—	7.05	6.50
Choice Cottonseed Meal	Hatfield	31.75	29.40	7.99	33	7.05	—	7.00	6.50
Choice Cottonseed Meal	N. Hadley	30.00	27.38	9.57	64	8.60	—	6.52	6.50
Choice Cottonseed Meal	Easthampton	30.50	27.09	12.59	703	6.97	—	6.45	6.50
Choice Cottonseed Meal	Hadley	30.00	28.18	6.46	846	8.90	—	6.71	6.50
Buckeye Cotton Oil Co., Cincinnati, O.									
Buckeye Cottonseed Meal	Deerfield	32.00	26.12	22.51	847	9.04	—	6.22	6.24
S. P. Davis, Little Rock, Ark.									
Cottonseed Meal	N. Amherst	32.20	26.54	21.33	24	8.67	—	6.32	6.50
Good Luck, Cottonseed Meal	N. Hadley	31.00	30.41	1.94	28	8.39	—	7.24	6.50
Good Luck, Cottonseed Meal	Sunderland	30.75	29.02	5.96	65	7.25	—	6.91	6.50
Good Luck, Cottonseed Meal	Sunderland	30.75	28.64	7.37	66	7.10	—	6.82	6.50
Good Luck, Cottonseed Meal	Sunderland	30.50	27.93	9.20	200	8.45	—	6.65	6.50
Good Luck, Cottonseed Meal	Holyoke	30.50	28.64	6.50	932	7.70	—	6.82	6.50

‡Valuation in excess of selling price.
*No. 1061 Phosphoric Acid 3.68%
" 2 " " 4.29%
" 567 " " 4.70%
" 858 " " 5.68%

NOTE—Castor pomace contains on the average 2.12 per cent of phosphoric acid and 1.20 per cent potash.

NOTE—Cottonseed Meal contains from 2 to 3 per cent of phosphoric acid and from 1.50 to 2.50 per cent of potash of which about 1.28% is water soluble.

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble.	Nitrogen in 100 lbs. Found. Organic.	Nitrogen in 100 lbs. Guaranteed.
COTTONSEED MEAL. (Concluded.)									
Humphreys, Godwin & Co., Memphis, Tenn.									
Dixie Brand Cottonseed Meal	Hadley	$30.00	$27.89	7.57	21	3.63	—	6.64	6.56
Dixie Brand Cottonseed Meal	Hadley	30.00	28.62	5.19	22	7.59	—	6.79	6.56
Dixie Brand Cottonseed Meal	N. Amherst	31.00	27.47	12.85	23	7.33	—	6.54	6.13
Dixie Brand Cottonseed Meal	Cushman	30.50	27.01	12.92	26	7.90	—	6.43	6.56
Dixie Brand Cottonseed Meal	Cushman	30.50	26.25	16.19	27	8.30	—	6.25	6.56
Dixie Brand Cottonseed Meal	Amherst	30.00	28.01	7.11	29	9.21	—	6.67	6.56
Dixie Brand Cottonseed Meal	Sunderland	31.00	27.30	14.54	30	6.88	—	6.50	6.18
Dixie Brand Cottonseed Meal	So. Deerfield	31.25	28.27	10.54	31	7.15	—	6.73	6.18
Dixie Brand Cottonseed Meal	Hadley	31.00	28.81	7.60	34	7.91	—	6.86	6.18
Dixie Brand Cottonseed Meal	Hadley	30.00	29.06	3.24	44	8.40	—	6.92	6.56
Dixie Brand Cottonseed Meal	Bradstreet	32.00	27.64	15.77	45	9.02	—	6.58	6.50
Dixie Brand Cottonseed Meal	Sunderland	30.00	27.22	10.21	63	8.35	—	6.48	6.56
Dixie Brand Cottonseed Meal	Sunderland	31.50	26.63	18.29	721	8.17	—	6.34	6.18
Dixie Brand Cottonseed Meal	Easthampton	31.00	27.34	13.39	845	9.01	—	6.51	6.18
Olds & Whipple, Hartford, Conn.									
Cottonseed Meal	Bradstreet	35.00	30.20	15.89	25	6.60	—	7.19	6.50
Geo. B. Robinson, Jr., New York City.									
Robin Brand Cottonseed Meal	Hatfield	30.00	27.51	9.05	202	7.93	—	6.55	6.50
W. Newton Smith, Baltimore, Md.									
Dirigo Brand Cottonseed Meal	Hadley	29.00	26.96	7.63	632	9.67	—	6.42	6.13
Dirigo Brand Cottonseed Meal	Hadley	29.00	26.12	11.03	633	10.02	—	6.22	6.13
Dirigo Brand Cottonseed Meal	Hadley	29.00	26.59	9.06	634	9.28	—	6.35	6.13
Dirigo Brand Cottonseed Meal	Hadley	29.00	26.38	9.93	688	9.06	—	6.28	6.13
J. E. Soper & Co., Boston, Mass.									
Pioneer Cottonseed Meal	Southwick	31.00	27.51	12.69	501	10.22	—	6.55	6.50

NOTE—Cottonseed Meal contains from 2 to 3 per cent phosphoric acid and from 1.50 to 2.50 per cent of potash, of which 1.28 per cent is water soluble.

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
HIGH GRADE SULFATE OF POTASH.								
American Agric. Chem. Co., Boston, Mass.								
H. G. Sulfate of Potash	Bradstreet	$52.00	$49.36	5.35	42	1.47	49.36	48.00
H. G. Sulfate of Potash	Sunderland	53.00	49.72	6.60	136	.44	49.72	48.00
H. G. Sulfate of Potash	Boston	55.00	50.72	8.44	553	.48	50.72	48.00
Bowker Fert. Co., Boston, Mass.								
H. G. Sulfate of Potash	Northampton	54.00	50.32	6.32	203	.30	50.32	48.00
" " " "	Boston	53.00			535			
Coe-Mortimer Co., New York City.								
H. G. Sulfate of Potash	Attleboro	52.00	50.48	3.01	305	.51	50.48	48.00
German Kali Works, Baltimore, Md.								
H. G. Sulfate of Potash	N. Amherst	50.10	49.68	‡ 2.07	421	.48	49.68	48.00
" " " "	Lawrence	50.00			505			
" " " "	Fitchburg	50.00			636			
" " " "	N. Amherst	44.50			777			
" " " "	Man. sample	—			983			
Lister's Agric. Chem. Works, Newark, N.J.								
H. G. Sulfate of Potash	Hockanum	52.00	50.76	2.44	772	.44	50.76	48.00
Mapes' Form. & Peruv. Guano Co., N. Y.								
H. G. Sulfate of Potash	Man. sample	—	51.92	—	1049	.13	51.92	48.67
National Fertilizer Co., Boston, Mass.								
H. G. Sulfate of Potash	Sunderland	50.00	50.56	‡ 1.11	440	.44	50.56	48.00
Nitrate Agencies Co., New York City.								
H. G. Sulfate of Potash	Sunderland	51.00	50.20	1.59	58	.30	50.20	48.00
H. G. Sulfate of Potash	Sunderland	51.30	49.58	3.47	148	1.56	49.58	48.00
Olds & Whipple, Hartford, Conn.								
H. G. Sulfate of Potash	Hockanum	54.00	50.32	7.31	319	.23	50.32	48.00
Patron's Co-Op. Asso., Boston, Mass.								
H. G. Sulfate of Potash	Marlboro	—	49.12	—	865	.83	49.12	—
Sanderson Fert. & Chem. Co., New Haven								
H. G. Sulfate of Potash	Sunderland	53.00	50.52	4.91	108	1.09	50.52	48.00
H. G. Sulfate of Potash	Southwick	52.00	48.32	7.62	519	1.02	48.32	48.00
Swift's Lowell Fert. Co., Boston, Mass.								
H. G. Sulfate of Potash	Springfield	53.00	50.00	6.00	969	.20	50.00	48.00
Whitman & Pratt Rend. Co., Boston, Mass.								
Sulfate of Potash	N. Chelmsford	50.00	39.04	28.07	887	.64	39.04	48.00
Wilcox Fert. Co., Mystic, Conn.								
H. G. Sulfate of Potash	Westfield	53.00	52.40	1.15	1031	.37	52.40	48.00
SULFATE OF POTASH-MAGNESIA.								
American Agric. Chem. Co., Boston, Mass.								
Double Manure Salt	Bradstreet	30.00	26.42	13.55	40	7.16	26.42	26.00
Double Manure Salt	Amherst	31.00	27.12	14.31	102	8.92	27.12	26.00
German Kali Works, Baltimore, Md.								
Double Manure Salt	Man. sample	—	21.52	—	982	.41	21.52	20.00
Double Manure Salt	Amherst	28.20	26.86	4.99	1001	.77	26.86	20.00
Mapes' Form. & Peru. Guano Co., N. Y. City								
Double Manure Salt	Conway	33.00	26.80	23.14	906	1.98	26.80	25.96
National Fert. Co., Boston, Mass.								
Double Manure Salt	Bradstreet	30.00	25.86	16 01	1	9.50	25.86	26.00

‡Valuation in excess of selling price.

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
SULFATE OF POTASH-MAGNESIA. (Concluded.)								
Olds & Whipple, Hartford, Conn.								
Sulfate of Potash-Magnesia	N. Hadley	$29.00	$26.34	3.04	150	.66	26.84	25.94
Sulfate of Potash-Magnesia	Hadley	29.00	27.16	6.73	416	.54	27.16	25.94
Sanderson Fert. & Chem. Co., New Haven								
Sulfate of Potash-Magnesia	Bradstreet	31.00	23.72	30.69	456	6.02	23.72	26.00
MURIATE OF POTASH.								
American Agric. Chem. Co., Boston, Mass.								
Muriate of Potash	Sunderland	43.00	42.64	4.36	154	.70	50.16	49.00
" " "	NewBedford	46.00			283			
Muriate of Potash	Boston	46.00	44.54	3.23	539	.99	52.40	49.00
Armour Fertilizer Works, Baltimore, Md.								
Muriate of Potash	Feeding Hills	43.00	35.59	34.87	973	.04	41.88	48.00
Atlantic Fertilizer Co., Baltimore, Md.								
Muriate of Potash	Millis	—	43.13	—	354	1.43	50.80	50.00
Bowker Fert. Co., Boston, Mass.								
Muriate of Potash	Northampton	45.00	40.29	13.32	227	1.35	47.40	49.00
" " "	Dighton	43.00			266			
" " "	Beverly	50.00			488			
Coe-Mortimer Co., New York City.								
Muriate of Potash	W.Springfi'd	42.10	41.96	3.79	945	.90	49.36	48.00
" " "	W.Springfi'd	45.00			959			
German Kali Works, Baltimore, Md.								
Muriate of Potash	Fall River	45.00	42.23	‡1.73	248	1.97	49.68	50.00
" " "	N. Amherst	38.00			774			
" " "	Marlboro	—			871			
" " "	Man. sample	—			933			
National Fertilizer Co., Boston, Mass.								
Muriate of Potash	Bradstreet	45.00	43.76	2.83	16	1.20	51.48	49.00
Muriate of Potash	Sunderland	45.00	42.94	4.80	441	2.39	50.52	49.00
Nitrate Agencies Co., New York City.								
Muriate of Potash	Sunderland	44.00	44.13	‡.30	56	2.18	51.92	50.00
Muriate of Potash	Amherst	42.50	43.55	‡2.41	104	3.15	51.24	50.00
Muriate of Potash	Amherst	42.50	42.53	‡.07	179	3.07	50.04	48.00
Olds & Whipple, Hartford, Conn.								
Muriate of Potash	Whately	47.00	43.66	7.65	1023	1.66	51.36	50.00
Sanderson Fert. & Chem. Co., New Haven								
Muriate of Potash	Sunderland	45.00	44.64	.31	129	.59	52.52	49.00
Muriate of Potash	Bradstreet	45.00	44.10	‡.23	419	1.01	51.88	49.00
" " "	Southwick	43.00			473			
Swift's Lowell Fert. Co., Boston, Mass.								
Muriate of Potash	Beverly	45.00	43.59	3.24	511	.98	51.28	50.00
Wilcox Fert. Co., Mystic, Conn.								
Muriate of Potash	NewBedford	46.00	43.01	5.56	231	1.24	50.60	50.00
" " "	Westfield	44.30			1041			
KAINIT.								
American Agric. Chem. Co., Boston, Mass.								
Kainit	Man. sample	—	12.47	—	1057	.45	14.67	12.00
Bowker Fertilizer Co., Boston, Mass.								
Kainit	Beverly	16.00	12.51	27.90	492	.54	14.72	12.00
German Kali Works, Baltimore, Md.								
Kainit	Framingham	12.50	11.23	11.31	713	3.34	13.33	12.00
"	Man. sample	—			936			

‡Valuation in excess of selling price.

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Phosphoric Acid in 100 lbs.							
						Moisture.	Water Soluble.	Reverted.	Insoluble.	Total.		Available.	
										Found.	Guaranteed.	Found.	Guaranteed.
DISSOLVED BONE BLACK.													
Amer. Agr. Chem. Co., Boston, Mass.													
Dissolved Bone Black	Fall River	$23.00	$15.64	47.12	*232	13.46	10.91	1.82	.92	13.65	16.00	12.73	14.00
Swift's Lowell Fert. Co., Boston, Mass.													
Dissolved Bone Black	Taunton	20.00	12.63	58.27	344	9.99	8.99	4.69	1.98	15.66	—	13.68	15.00
ACID PHOSPHATE.													
Amer. Agr. Chem. Co., Boston, Mass.													
Plain Superphosphate	Fall River	17.00	12.95	31.27	242	11.44	11.14	2.92	1.45	15.51	15.00	14.06	14.00
Atlantic Fert. Co., Baltimore, Md.													
Atlantic Dissolved Phosphate	Millis	—	15.56	—	404	12.27	15.22	1.83	.99	18.04	—	17.05	16.00
Atlantic Dissolved Phosphate	N. Amherst	15.60	13.66	12.01	413	11.74	12.54	2.61	.69	15.84	14.50	15.15	14.00
" " "	Montague	15.00			923								
Bowker Fert. Co., Boston, Mass.													
Bowker's Acid Phosphate	Northampton	17.50	15.03	21.42	224	12.52	11.80	5.19	.66	17.65	15.00	16.99	14.00
" " "	Whitman	19.00			430								
Bowker's Acid Phosphate	Milford	16.00	12.94	23.65	746	10.20	10.75	3.31	1.53	15.59	13.00	14.06	12.00
Coe-Mortimer Co., New York City.													
H. G. Soluble Phosphate	Hockanum	15.50	12.56	23.41	318	7.75	8.93	5.23	.86	15.02	15.00	14.16	14.00
German Kali Works, Baltimore, Md.													
Acid Phosphate	Manft'r's sample	—	12.27	—	989	12.01	9.69	4.11	.64	14.44	—	13.80	14.00
National Fert. Co., Boston, Mass.													
Chittenden's Plain Superphosphate	Bradstreet	19.00	15.48	22.74	12	13.85	15.24	1.98	.44	17.66	17.00	17.22	16.00
Nitrate Agencies Co., New York City.													
Acid Phosphate	Concord	15.00	12.42	24.80	364	9.05	8.99	4.85	1.12	14.96	14.00	13.84	14.00
" "	Chelmsford	16.00			555								
Olds & Whipple, Hartford, Conn.													
Acid Phosphate	Hockanum	17.00	14.37	18.30	317	14.53	14.32	1.70	.31	16.33	—	16.02	16.00

*Water soluble potash, 3.32%; nitrogen .39%

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.
ACID PHOSPHATE. (Concluded.)													
SandersonFert.&Chem.Co.,NewHaven													
Plain Superphosphate	Sunderland	$17.00	$15.74	8.00	128	10.12	14.03	2.02	3.72	20.15	·	16.05	14.00
Plain Superphosphate	Bradstreet	18.00	13.33	35.03	458	9.49	8.20	6.14	2.60	16.94	—	14.34	14.00
" "	Southwick	18.00			480								
Swift's Lowell Fert.Co., Boston, Mass.													
Acid Phosphate	Fitchburg	15.50	12.44	30.63	675	9.80	10.43	3.68	.28	14.39	14.00	14.11	12.00
" "	Sterling	17.00			821								
Whitman&PrattRend.Co.,Lowell,Mass													
Acid Phosphate	N. Chelmsford	14.00	12.08	15 89	889	8.94	6.57	7.29	.86	14.72	—	13.36	12.00
Wilcox Fert. Co., Mystic, Conn.													
Acid Phosphate	Westfield	17.30	15.57	11.11	1029	10.43	13.84	3.76	.26	17.86	—	17.60	16.00
BASIC SLAG PHOSPHATE.													
Amer. Agr. Chem.Co., Boston, Mass.													
Basic Slag	Sunderland	17.00	† 11.55	47.18	152	.15	—	11.81	5.26	17.07	17.00	11.81	.50
Basic Slag	Northampton	17.75	† 12.44	31.67	209	.20	—	14.09	2.93	17.02	17.00	14.09	.50
" "	Concord	15.00			390								
Basic Slag	Maynard	17.60	† 13.90	26.62	813	.05	—	16.48	1.79	18.27	17.00	16.48	.50
Bowker Fert. Co., Boston, Mass.													
Basic Slag	Milford	15.60	† 13.48	15.73	739	.09	—	15.87	1.94	17.81	17.00	15.87	.50
Coe-Mortimer Co., New York City.													
Basic Slag	Seekonk	18.50	† 13.46	17.98	306	.04	—	15.89	1.37	17.76	17.00	15.89	*15.00
" "	Hockanum	15.00			322								
" "	Concord	15.00			358								
" "	Concord Jct.	15.00			387								
Patrons' Co-op. Association, Boston.													
Basic Slag	Sunderland	15.00	† 13.08	14.68	454	.11	—	14.00	4.69	18.69	18.00	14.00	—
" "	Marlboro	—			863								
SandersonFert.&Chem.Co.,NewHaven													
Basic Slag	Sunderland	18.00	† 12.33	45.99	130	.17	—	14.36	2.10	16.46	16.00	14.36	—
PHOSPHATE ROCK.													
Amer. Agr. Chem. Co., Boston, Mass.													
Ground Untreated Phosphate Rock	Pratt's Junction	15.00	12.03	24.70	856	1.60	—	—	—	30.08	30.20	—	—

*Guarantee based upon Wagner's method of analysis.

†Valuation based upon availability of phosphoric acid as determined by Wagner's method of analysis, which shows the phosphoric acid dissolved by a 2 per cent citric acid solution. The available phosphoric acid is valued at 4 cents and the insoluble at 2 cents per pound.

BULLETIN No. 141. SEPTEMBER, 1912

MASSACHUSETTS
AGRICULTURAL EXPERIMENT
STATION.

THE MICROSCOPIC IDENTIFICATION OF CATTLE FOODS

By G. H. CHAPMAN

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

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AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

CONTENTS.

THE MICROSCOPIC IDENTIFICATION OF CATTLE FOODS.

By G. H. Chapman.

INTRODUCTION.

The microscopical examination of stock feeds, condimentals and poultry feeds, that is, practically all the commercial feeding stuffs of the United States, has not been taken up systematically to any great extent thus far. Although several books have appeared dealing with the microscopical examination of vegetable foods, spices and technical products, no single work has appeared which has dealt exclusively with the microscopical examination of commercial feeding stuffs. This phase of microscopy is becoming more and more important, as the number of commercial feeds put out each year by various manufacturers increases.

The examination of stock feeds microscopically is much more difficult in a way than the examination of vegetable foods, inasmuch as there are as a rule a great many different constituents in a stock feed, especially in condimentals. The commercial feeding stuffs may be enumerated briefly as follows: cotton-seed meals, linseed meals, gluten meals, corn products, wheat feeds, mixed feeds, sugar and molasses feeds, miscellaneous feeds, proprietary stock feeds, animal meals and poultry feeds, and these may be classed under a few general heads, viz: 1st, cereal products, under which come the grains; 2nd, byproducts such as linseed, cotton seed, corn cobs, malt sprouts, peanut residues, distillers' grains and the like; 3rd, animal residues including animal meal, bone meal, dried blood; 4th, mineral residues such as ground rock, ground oyster shells and sand; 5th, weed seeds. Most condimental feeds contain in addition one or more drugs of vegetable or mineral origin. Under the first may be placed such substances as anise, capsicum, fennel, fenugrec, gentian and ginger. Under the second head such chemicals as alum, calcium carbonate, charcoal, iron oxide, resin, saltpetre and Epsom salts.

It is especially important that in addition to having a thorough knowledge of the appearance of the whole grain and its various

parts, the microscopist should be thoroughly familiar with the weed seeds which always occur to a greater or less extent in cereal products. While the greater part of them are without harmful effects, two or three more commonly occurring seeds are injurious to cattle and poultry. Halsted[1] and likewise the United States Department of Agriculture[2] have put out a collection of the more commonly occurring seeds which will be found of inestimable assistance to the microscopist.

In this bulletin it has been our object to cover the ground in as brief a manner as possible and yet give the essential elements of a substance, so as to render its diagnosis certain. It cannot be taken as a complete treatise on the subject, but it is hoped that the more important products have been covered. Free use has been made of all the literature available and credit given to the proper authorities.

No directions have been given for methods of mounting or clearing sections and fragments of tissue, but these can easily be found in Winton[3] or other books on technique. A set of sieves of different sizes will be found convenient to separate the feed into portions of different sized particles. A good hand lens and compound microscope will also be necessary, but as the mounting is only temporary, no extensive apparatus is required.

ACKNOWLEDGMENTS.

The author at this time wishes to express his appreciation of the kindness of Dr. E. A. Bessey, of the Michigan Agricultural Experiment Station for the loan of parts of Figs. 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, and 40; also to Messrs. Wiley and Sons for loan of Fig. 9. Many other figures have been adapted, partially at least, from Winton's "Microscopy of Vegetable Foods". The author wishes to thank Drs. Stone and Lindsey and Mr. Smith, of this Station, for valuable suggestions and material often donated; also Mr. R. E. Torrey for many of the drawings.

1 One Hundred Species of American Weed Seeds. Issued by B. D. Halsted New Brunswick, N. J.

2 Distribution of Economic Seeds, U. S. Dept. Agr., Prepared in Seed Laboratory by F. C. Coville and G. H. Hicks. Issued 1898.

3 Microscopy of Vegetable Foods, (Wiley & Sons).

PART I.

GENERAL CHARACTERISTICS AND IDENTIFICATION OF GRAIN AND GRAIN PRODUCTS.

WHEAT.

(*Triticum sativum var. vulgare, Hack.*)

Common wheat, or some portion thereof, is a very common constituent of many cattle foods. The grain of wheat is oval

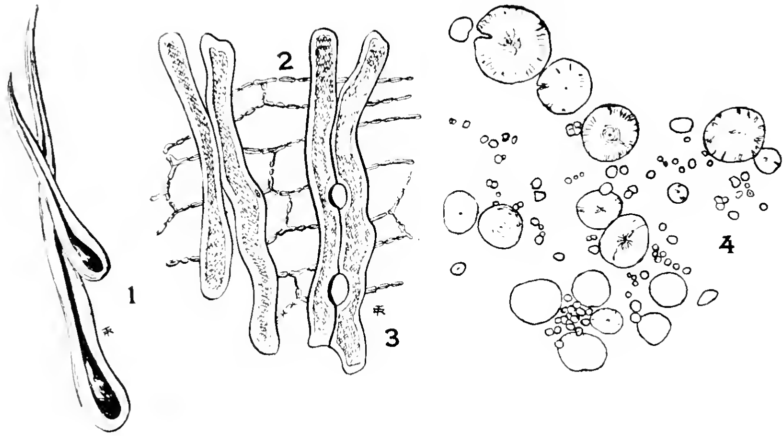

Figure 1

Fig. 1. Wheat. (1) Hairs from apex of grain; (2) Cross cells and (3) tube cells. (4) Wheat starch.

lengthwise and somewhat heart-shaped in transverse section, with a depression at the lower end, and a deep depression or groove on the ventral side, and has a slight beard on the upper end. In color the kernel varies from light yellow to brown. No more detailed description of the grain is necessary as its appearance is familiar to every one. In feeds it may occur as middlings, a product intermediary between flour and bran, or as bran which is composed chiefly of the seed coats of the kernel; and also it may occur in simply cracked form. In all the different products there is usually starch present, which greatly aids in the diagnosis. Other elements which are of aid also in the diagnosis are the hairs, the cross cells and the tube cells.

Wheat starch is composed of two distinct forms of grains,

namely, large lenticular grains from 30—40μ in diameter, with faintly visible laminae and hilum, and small rounded or somewhat polygonal grains less than 8μ in diameter. With polarized light, indistinct crosses are evident, and the selenite plate gives but a faint display of colors.

The hairs, which are found up to 1 mm. in length, are usually awl shaped, with a rounded base about 25 μ in diameter. The cell cavity, which appears black under the microscope, is much narrower than the hair walls, but extends well up into the tip of the hair.

The cross cells are found in the bran coats and are more or less characteristic of wheat. They are transversely elongated, and are arranged side by side in rows, with porous cell walls. Usually the cells are from 100—200 μ long and 15—25 μ in diameter. The side walls are about 4—7 μ thick, but the end walls are usually much thinner, and are not swollen by alkali; a distinction from rye.

Crossing this layer of cells are usually found more or less detached layers of cells to which the name of tube cells is given. These cells vary greatly in size, but are characteristic of wheat, as in the case of the other cereals this layer of cells is less broken up.

The starch grains and the cross cells are the most useful elements in diagnosing wheat products. Fig. 1 shows the elements noted.

MAIZE—INDIAN CORN.

(*Zea Mays, L.*)

Indian corn is one of the most important constituents of cattle foods; it occurs in various forms, such as cracked corn in which the kernel is broken up into large, coarse fragments; corn meal, a finer ground feed; hominy feed in which the particles are ground very fine and in which some of the bran is usually present, and corn and cob meal which contains besides the corn, ground fragments of the cob.

The horny part of the kernel is usually white or yellow in color, and has usually enough of the starch endosperm adhering to suffice for identification. The coarser particles are readily

recognized with the naked eye, and the more finely ground feeds are to a great extent recognized by the characteristic starch

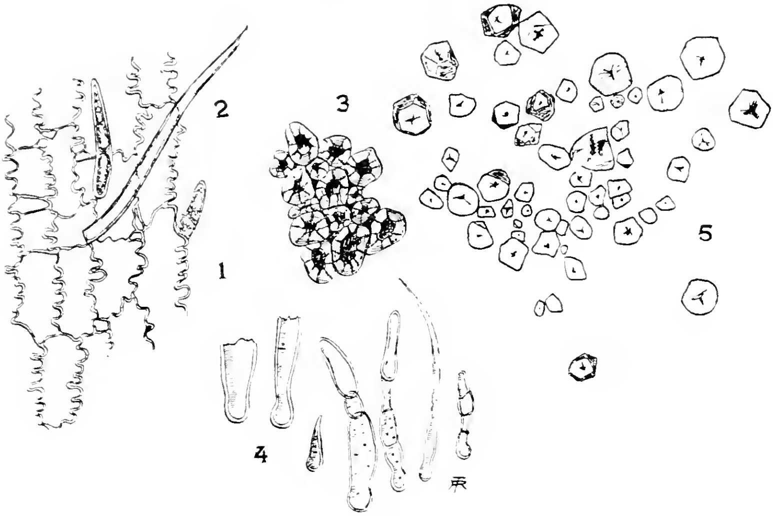

Figure 2

Fig. 2. Maize. (1) Epidermis and (2) single and multiple celled hairs from glume. (3) Cells from woody zone, and (4) hairs from cob. (5) Corn starch.

grains. The grains are roughly polygonal in shape and vary in size fron 15—30 μ in diameter. The hilum is distinctly visible and usually has radiating clefts. The laminae or rings are not visible under normal conditions, and the grains do not occur in compact aggregates as do some of the other polygonal starches. The only other starches likely to be confused with that of maize, are those of the broom corn, and these are practically the same and it is impossible to differentiate them.

The presence of ground cob in a feed is easily determined also, and the two or three characteristics given below are sufficient for its identification.

Fragments of the glumes and palets can be picked out and examined under the microscope, the cells having wavy walls, and often one to three or four celled hairs are present. Thickened glumes consisting of woody tissue are usually present and the characteristic stone cells are another aid in the diagnosis.

The presence of ground cob in meal can often be detected by chewing a portion of the feed, when the hard woody fibre of the cob can be felt in the mouth.[1]

The hairs found in corn cob vary greatly in size and shape. The single celled hairs, however, are usually long, with a cell cavity or lumen several times thicker than the walls of the hair, extending well up into the tip. The multicellular hairs seem to have thicker walls, and are usually shorter, with a blunt tip on the terminal cell and are often pitted. These elements are shown in Fig. 2.

RICE.

(Oryza sativa, L.)

Rice used largely as a human food, is now being found in cattle feeds. When the grain itself is found in the feed the identification is a simple matter, as it depends entirely on the starch grains which have a characteristic size and appearance. They are sometimes distorted, owing to a cooking process, but can ordinarily be identified without much trouble. The starch

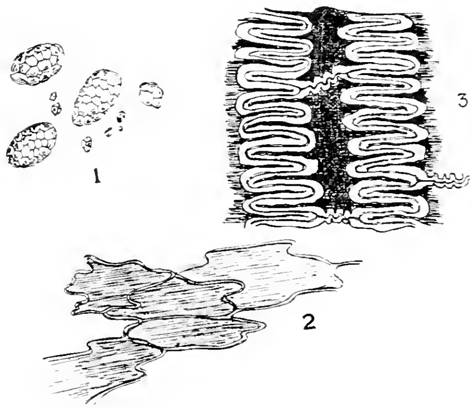

Figure 3

Fig. 3. Rice. (1) Rice starch; (2) Cells from epicarp; (3) Epidermal cells.

grains are in size the smallest of the polygonal starches, having a range of from 2—9 μ in diameter, very rarely exceeding the latter

1 J. B. Lindsey, Mass. Ag'l. Exp. Sta.

size. They are found singly and in aggregates of from two to many grains. Sharply polygonal grains predominate, but there are also many grains with one or more rounded facets which come from the outer portion of the aggregates, which are oval in form and usually present. No laminae are visible, but the hilum is as a rule evident and is central. With polarized light distinct crosses are seen, but it is extremely difficult to observe any marked play of colors with the selenite plate.

Rice hulls and rice bran are sometimes found in food stuffs. The chief distinguishing characteristics of rice hulls are the rectangular epidermal cells with thick convoluted walls. These are best seen when the preparation is cleared with chloral hydrate or potash. Another striking characteristic of the hulls is the broadly linear-lanceolate hairs which are abundant along the edges of the glume. When a dry portion of the layer is scraped with a needle its silicious character is easily detected.

Rice bran may be identified by the cells of the epicarp. These cells are from 100—500μ long and from 30—100μ in width; are transversely elongated and have peculiar wavy end walls. (Fig. 3.) They are arranged side by side in rows. The presence of rice starch is usually noted in all rice bran preparations. Bran, however, is not in general use at present as a cattle food.

MILLET.

(*Panicum miliaceum, L.*)

Millet is one of the oldest cereal grains known and is still

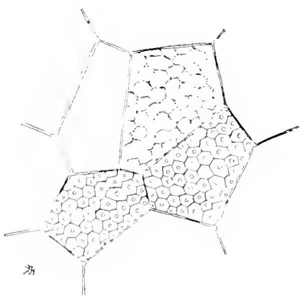

Figure 4

Fig. 4. Millet. Starch cells showing beaded network left after treating with dilute alkali.

used extensively. When found in commercial feeding stuffs it is usually present as the whole grain. The seed itself is tightly enclosed in the glumes and palets. In size it is 2—3 m.m. long and from 1.5—2 m.m. broad, and in shape a more or less laterally flattened ellipsoid, with the ends of the long diameter slightly pointed. Its color varies from a light yellow straw color, through orange to brownish yellow. The surface of the seed is smooth and shiny. The starch contained in the endosperm is dissolved by dilute alkali, leaving a beaded cell wall behind. (Fig. 4.) The ground seed has not been observed in cattle feeds. It finds its chief use in chick feeds, forming sometimes 10% of the whole feed. For further means of identification Winton's "Microscopy of Vegetable Foods" may be consulted.

RYE

(Secale cereale, L.)

Rye is occasionally found in cattle feeds, and there are a few differences in structure between it and wheat so that its identi-

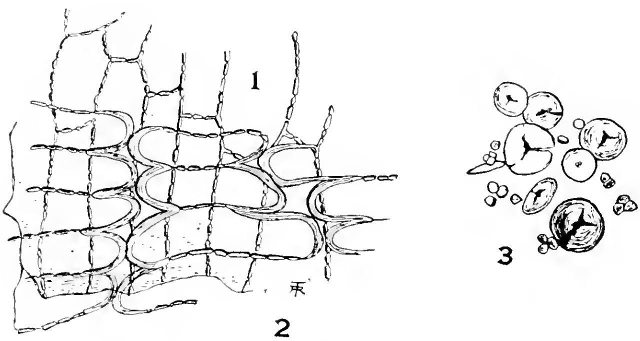

Figure 5

Fig. 5. Rye. (1) Cells of epicarp, and (2) cross cells; (3) Starch grains.

fication is comparatively simple. The kernels are longer and more sharply pointed at the ends, especially at the base, and are darker in color than those of wheat.

The epicarp or outer layer of cells in rye are about the same size but have thinner walls and are less distinctly beaded than in wheat. The cell cavity or lumen of the hairs remains relative-

ly broad even to the apex of the hair in rye, while in wheat it becomes merely a line as it approaches the apex.

The cross cells are arranged side by side in rows and are 100—200μ long, and 15—35μ wide. The side walls of these cells are thinner than those of wheat, and the end walls are often swollen, with intercellular spaces; in wheat the end walls are thinner than those of the sides and there are no intercellular spaces.

The starch grains are also of aid in the diagnosis of rye products, they being of two distinct sizes, the larger averaging about 50μ but often exceeding this size, of a circular disk shape and showing rings (laminae) and fissures radiating from the hilum. The small grains are round or angular and are from 8—14μ in diameter and are more numerous than the small grains of other similar starches.

Fig. 5 shows the different elements of rye which are useful in the diagnosis of this grain when found in mixtures.

BARLEY.

(*Hordeum sativum, L.*)

Barley or some of its by-products are of common occurrence in cattle feeds, and as there is some similarity between it and the other grains, as wheat and rye, it is sometimes rather difficult to diagnose unless the whole kernel, coarsely ground, is present, although some of the characteristics differ from others of this group. The grain itself is shaped much like that of wheat, but the glumes adhere more firmly to the seed and there are found five prominent ribs which are not noticeable on other grains of this character. The lateral depression is also more marked in barley than in other grains.

The epidermal cells of the glumes are strongly silicious in character. There are three forms found; first, long cells with thick wavy side walls; second, elliptical or circular cells which have the appearance of short hairs and also circular or elliptical cells which are usually found in pairs. These elements are shown in Fig. 6.

The parenchyma cells of barley are rectangular in shape, with thin walls, and large, roughly circular intercellular spaces which are more or less characteristic of this grain.

The hairs found in barley are of two kinds, one of which has walls thinner than the cell cavity and are less than 150μ long

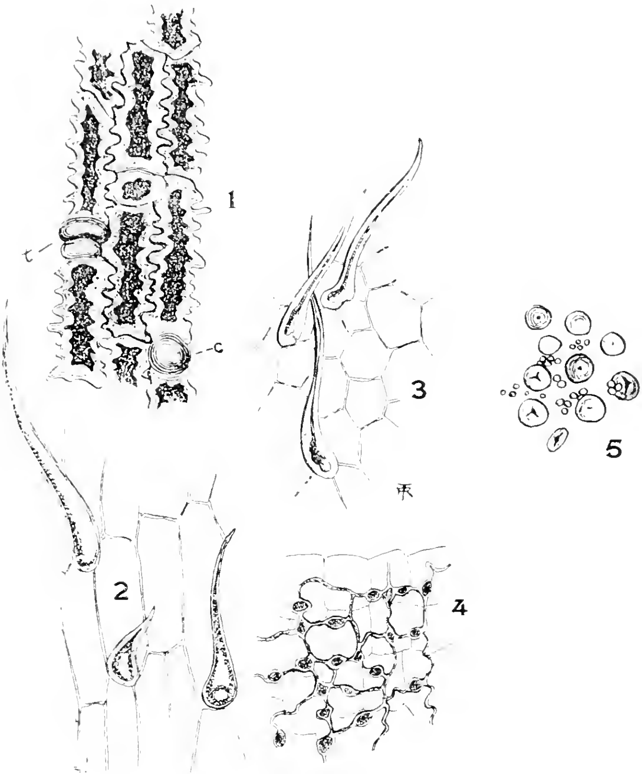

Figure 6

Fig. 6. Barley. (1) Palet showing (t) twin cells and (c) circular cells; Hairs from (2) inner and (3) outer epidermis; (4) Spongy parenchyma and (5) starch grains.

usually, and the second in which the hairs are somewhat shorter, and have very thick walls and a narrow cell cavity or lumen.

The starch grains are also of use in the diagnosis of barley and are usually found in most of the by-products. They are of two sizes; large grains circular or disk-shaped from 20—30μ in diameter, and smaller grains less than 7μ in diameter. The hilum is not always evident, but is sometimes cleft. The small grains

are spherical in shape for the most part, and do not occur in aggregates. Two by-products of barley will be dealt with under grain products; namely, brewers' grains, and malt sprouts.

OATS.

(*Avena sativa, L.*)

Oats, either whole, crushed or ground, form one of the chief ingredients of many cattle foods and are a very important article of food. In general appearance the oat is similar to other cereals, but is easily distinguished by the smooth glossy glume which is

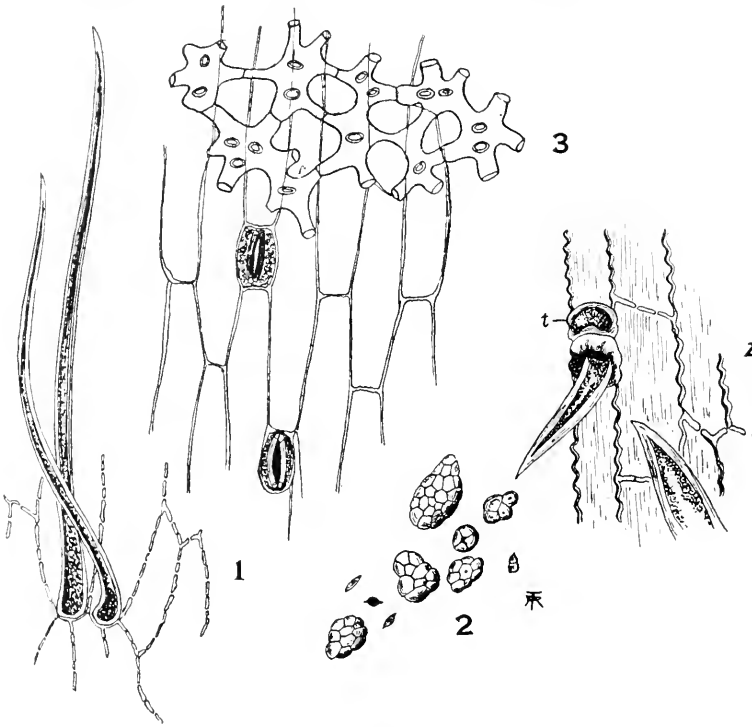

Figure 7

Fig. 7. Oats. (1) Epicarp with long hairs; (2) Starch grains and aggregates; (3) Spongy parenchyma; (4) Hairs and (t) crescent cells from outer epidermis.

not ribbed as in barley. The grain itself is spindle shaped and very narrow, compared with wheat or barley, and has a *shallow*

groove on the ventral side. Under the microscope the epidermis of the glume is seen to be made up of elongated thick walled cells, and twin cells which are more or less crescent shaped. (Fig. 7.) The parenchyma cells are roughly star shaped, a distinguishing feature from the other cereals.

The hairs at the apex of the grain are long and narrow, measuring up to 250μ in length and are about 20μ in diameter in the middle, the base often tapering almost to a point. Other thick walled hairs are often found which measure up to 100μ in length and have a broad base measuring 20μ or less in diameter. These hairs, however, are stiff while those found at the apex of the grain are more or less wavy.

In ground products the starch grains are the most characteristic element, being polygonal in shape for the most part and from 5—8μ in diameter. Rounded aggregates, composed of from few to many grains often occur. The spindle shaped grains very often found are characteristic of oats.

BUCKWHEAT.

(*Fagopyrum esculentum, Moench.*)

Buckwheat is occasionally found whole or ground in cattle and

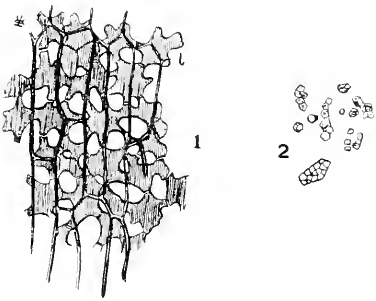

Figure 8

Fig. 8. Buckwheat. (1) Spongy parenchyma and (1) inner epidermis; (2) Starch grains.

chick foods. When whole the seed is sharply triangular, pointed, and varies in color from gray brown to dark brown. In size it ranges from 5—8 m.m. in length and from 3—4 m.m. in breadth. All products are easily identified by the tissues of the spermoderm and

the starch grains. The spermoderm or inner covering of the seed is yellowish is color and made up of three layers, the outer epidermis being made up of wavy-walled rectangular cells of varying size. Under this is found a second layer of spongy parenchyma, the cells of which are very irregular in both size and shape, and between which are found a great many circular intercellular spaces. The cell content is yellowish or greenish in color. This layer is characteristic of buckwheat.

The grains of buckwheat starch are either sharply polygonal or sphaero-polygonal with one or more facets, and range in size from 5—12μ in diameter. Angular or rod-like aggregates are often present but large oval aggregates are never found. Occasionally an isolated, angular cell of the starch parenchyma will be found in which the grains entirely fill the cell. After treatment with alkali the starch cells show a network of homogenous threads throughout the cell. Fig. 8 shows the elements of buckwheat mentioned above.

KAFFIR CORN.

(*Andropogon Sorghum, Brot.*)

Several varieties of sorghum have been grown in the past, and now the grain is becoming more important as a food for stock and other farm animals. It is often found also in chicken feeds, in a more or less coarsely ground condition. When found finely ground, the glumes removed, it is very difficult to distinguish it from corn meal, as the starch grains of Kaffir corn

Fig. 9. Kaffir Corn.

show practically no differences in structure from those of maize. As a rule, however, the glumes adhere somewhat to the grain, and as they are in color reddish brown to almost black, one can usually find fragments by which the product can be identified. The glumes also tend to darken the ground product. When coarsely ground the pieces are rather easy to identify on account of the color and shape of the grain. The whole grain is

nearly globular in shape, dependent somewhat on the variety and is about 4 m.m. in diameter, in color varying from white through red, brown, to almost black, with mottled grains of two or more colors. Its microscopic structure varies very little from that of any broom corn and only a very few elements differ in microscopic structure to any extent from those of other cereal grains.

The starch grains are very similar to those of maize, being as a rule sharply polygonal with a distinct hilum, and often showing radiating clefts. In size the grains are up to 30μ in diameter, but average about 20μ, very few reaching the former size.

As a rule it is comparatively easy to identify Kaffir corn in a mixture, but if a more detailed description of differences in structure is deemed necessary, Winton[1] gives a complete and particular description of all the different tissues found, and the comparisons with other grains. Fig. 9 shows this grain.

BREWERS' GRAINS.

Brewers' grains are the residue of the mash left after beer brewing and consist of the barley grains after the starchy and soluble matter has been removed. They are fed both wet and dry, but as commonly occurring in cattle feeds are in the dry form. They show more or less the characteristics of ground barley (see barley), with the exception of the starch grains, although these also may be found. Usually a sourish characteristic odor is associated with them, dependent somewhat on their age. The tissues may be more or less disintegrated but can usually be identified very easily.

DISTILLERS' GRAINS.

These are the dried residue from the manufacture of spirits, made from the grains of corn, rye, oats and barley. Usually they are more disintegrated than brewers' grains and may be a little harder to diagnose, but usually the cooking process does not destroy the tissues sufficiently to render diagnosis impossible. The methods used in connection with the grains are employed with the exception of the starch determination. Occasionally a sour odor will be noticed.

1 Microscopy of Vegetable Foods, Winton.

MALT SPROUTS.

Malt sprouts are the radicles which are rubbed off in the preparation of malt from barley. When dry they are of a pale straw color. Under the microscope they are almost colorless with a darker central portion.

The surface cells are roughly rectangular in shape, and from the centers of these cells many typical root hairs grow. The hairs

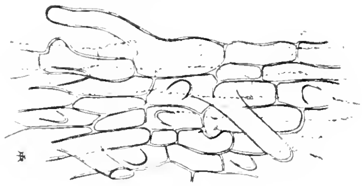

Figure 10
Fig. 10. Malt Sprouts. Epidermis with root hairs.

are of different lengths and have blunt rounded points. Usually, however, they are easy to identify with the naked eye. Fig. 10 shows a typical sprout with hairs.

GLUTEN FEED.

This is the dried residue obtained in the manufacture of starch and glucose from corn, and as sold for cattle food, consists usually of all the remaining tissues, including the gluten, left after the starch has been removed. This product is best diagnosed by the tissues mentioned under corn, with the exception of the starch grains, which are altered and greatly distorted. Those brands of gluten feed which are artificially colored a bright yellow, are easily detected by a chemical examination. The Pure Food Law now requires feed stuffs which carry artificial coloring matter to be so labeled.

BREAKFAST CEREAL REFUSE, ETC.

Occasionally there will be found in feeds certain forms of damaged cereal preparations, such as rolled oats, but these can be identified usually without the aid of the microscope. If, however, it is necessary to make a more particular examination, the use of the tissues mentioned under the grains will be sufficient.

PART II.

GENERAL CHARACTERISTICS AND IDENTIFICATION OF LEGUMES AND OIL SEEDS.

PEA.

(*Pisum sativum, L.*)

Both field and garden peas are sometines found in commercial feed stuffs and are so well known in their whole state as to require little description. The field peas are, however, of a brownish color and smooth, while those of the latter class are pale green and may have a roughened surface. Both classes are nearly spherical in shape. As a rule they are found in ground condition.

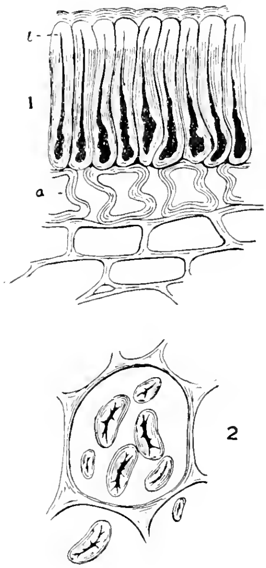

Figure 11

Fig. 11. Pea. (1) Palisade cells with (l) "Light" line, and (a) hour glass or "figure eight" cells; (2) Pea starch.

When the whole pea is ground the identification is very easy as the grains of pea starch are characteristic. They are ellipsoidal or roundly elliptical, and often have rounded protuberances on the grain. In size they are rarely over 40μ through their longest diameter. The laminae are usually distinct and the hilum much

elongated, but seldom distinctly cleft. With polarized light, beautiful distinct crosses are shown and with the selenite plate a brilliant play of colors is displayed.

In case the hulls alone are used in the feeds, starch grains may not occur and their presence may be detected by the appearance of the seed coats under the microscope. The size and appearance of the palisade cells (Fig. 11) and the column cells of the spermoderm are the best means of diagnosis. The palisade cells are from 60—100μ in length and have a "light line" immediately under the cuticle. They also have a lumen or cell cavity of irregular shape. The column cells which constitute the layer next below the palisade layer are shaped like an hour glass or "figure 8", and are in the pea never more than 20μ in length. This layer of column cells is only one cell thick. These cells are easily isolated by heating and macerating with dilute alkali, and they do not contain crystals, a distinction from the column cells of other leguminous seeds.

BEAN.

(*Phaseolus vulgaris, Metz.*)

There are several varieties of beans used as food by man, and some of these are occasionally found in commercial stock feeds. These are never found whole, but are either ground coarsely or simply the hulls are used. The whole bean is more or less kidney shaped, and longer than it is broad, although the different varieties vary greatly in their measurements and the color also varies greatly, white, brown, red, spotted and black being found.

When the common ground bean is present the starch grains are sufficient for its identification. These are large ellipsoidal, kidney shaped grains from 16—60μ in length, with the laminae distinct, hilum elongated and conspicuously cleft; with polarized light, brilliant, distinct crosses are seen and with the selenite plate a fine play of colors is obtained.

In the absence of starch grains elements of the spermoderm are sufficient for identification. The palisade cells are elongated, (rarely over 60μ long,) narrow and have a "light line" immediately under the cuticle. This light line is characteristic of most of the leguminous seeds, and each cell has a lumen, or cell cavity,

more or less oval in shape, which is very distinct. The column cells are roughly hexagonal in shape, with thickened cell walls,

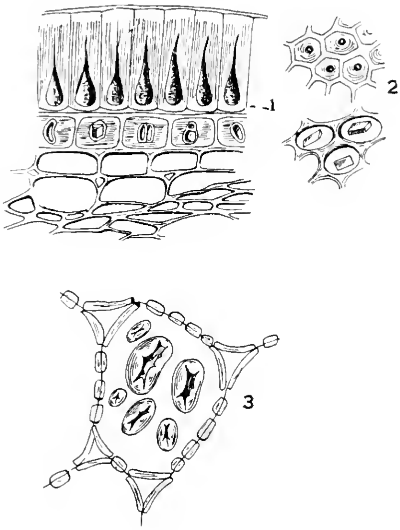

Figure 12

Fig. 12. Bean. (1) Palisade cells with "light" line; Subepidermal cells with calcium oxalate crystals; (2) Palisade cells in cross section; (3) Starch grains.

but no intercellular cavities. This layer of cells is only one cell thick. Each cell contains one large monoclinic crystal of calcium oxalate; very rarely more than one crystal is present, and never more than two at the most. Fig. (12) shows the elements mentioned in connection with the common bean.

CAROB BEAN.

(*Ceratonia Seliqua, L.*)

Ground carob beans are used as a cattle food to some extent, and while in general the seeds resemble those of other legumes, there are a few characters which make the identification of the ground product a comparatively simple matter. In the cells of the mesocarp are found large, brown, wrinkled bodies, which are characteristic; on treating with dilute alkali and heating carefully a deep blue or violet color is obtained. The long palisade cells

of the seed are also characteristic; they are from 170—250μ in length, of which an outer layer of about 1-5th the total height

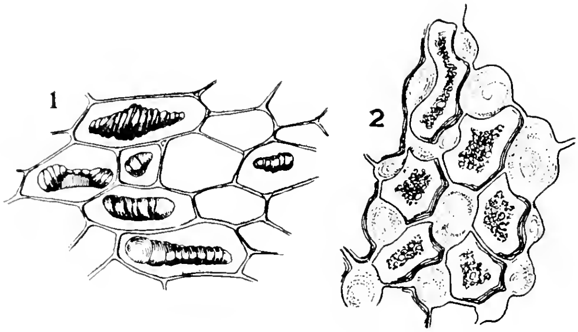

Figure 13

Fig. 13. Carob Bean. (1) Wrinkled bodies in cells of mesocarp and (2) endosperm cells with thickened walls.

is swollen and shows no cell cavity. The endosperm cells are striking on account of the enormously thickened cell wall. These cells are best seen in sections cut from the white horny fragments of the seed. Fig. 13 shows the elements of the carob bean which have been mentioned.

SOY BEAN.

(*Soja hispida, Moench.*)

Soy beans are sometimes found in cattle feeds, but are usually ground into the form of meal. The seed itself varies from 5—10 m.m. in diameter, and is usually nearly globular, but occasionally is somewhat flattened. The color is varied, being yellow, brown or even black.

In general the elements of the seed resemble greatly other legumes, but it is characterized by the absence of all starch grains, and the presence of thick walled layers of spermoderm cells which have a proteid content. This layer is not always easy to find in ground preparations, but is quite characteristic. The cells themselves are rectangular or polygonal in shape and are from 15—45μ in diameter.

The palisade cells are about the same as those of the common bean, but the column cells are thicker and heavier looking than

those of most legumes. In length they vary from 30—60μ, occasionally being found longer than this. In width they vary from 16—40μ. It is usually easy to find these cells in a preparation

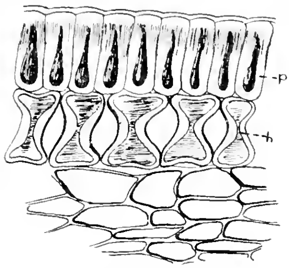

Figure 14

Fig. 14. Soy Bean. (p) Palisade cells with "light" line, and (h) very heavy hour glass cells.

as they easily separate from the other elements and are found isolated in the ground product.

The absence of starch, together with the presence of the column cells and palisade layer prove usually the presenee of soy bean in a preparation. Fig. 14 shows the elements noted above.

FENUGREC.

(*Trigonella Foenum—Graecum, L.*)

Fenugrec seeds are used in condimental foods and condition

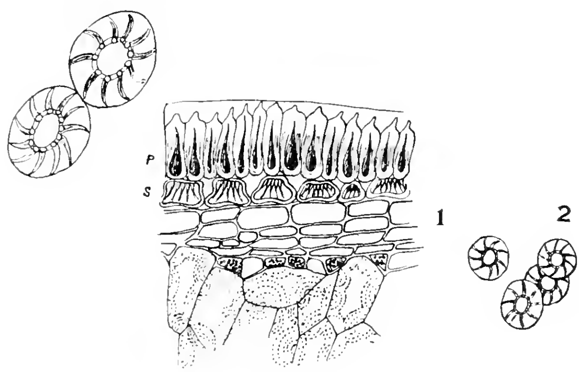

Figure 15

Fig. 15. Fenugrec. (1) Cross section showing (p) palisade cells and (s) subepidermal layer showing radiating cells; (2) Surface view of subepidermal layer.

powders and are usually found in ground condition. When present the characteristic taste and odor are of great importance as an aid to diagnosis. The taste is bitter and mucilaginous and the odor peculiar and characteristic. The seeds themselves are about 3 m.m. long and from 1.5—2 m.m. thick, oblong in shape and somewhat flattened. The ground powder is yellowish-brown in color, but contains no starch grains.

The palisade cells and column cells are the elements which are useful in the diagnosis of fenugree. The palisade cells are 60—75μ high and from 8—20μ wide, and the cell cavity, which is very broad at the base, tapers to a point at the top of the cell.

The cell walls are pointed at the top as a rule, but sometimes blunt ended cells are found, these always being higher than the pointed cells. A narrow "light line" is found about 30μ from the top of the cells.

The column cells are short and broad, and are highly characteristic; they are about 20μ high, hour-glass shaped, very wide at the base, or inner portion, the upper end being smaller. The walls are ribbed, and when seen in surface view give a radiating effect. The cells are varying in size, ranging from 30—75μ in breadth. These elements are easily found in the ground product, which contains fragments of the hulls. No other elements are of use in the diagnosis. Fig. 15 shows the seed and the elements noted above.

PEANUT.

(*Arachis hypogaea, L.*)

Peanuts and peanut shells are used in a variety of ways as foods, but it is usually in a ground condition that they find their way into cattle foods. Usually the whole fruit is crushed or ground, and is as a rule immature or damaged. Lately, however, another form has appeared on the market which consists chiefly of the radicle, and is designated as "peanut germs", but it is not in general use as yet, being found only locally.

The cells of the fibre layer of the pericarp or shell are of great use in diagnosing a whole peanut product. Their shape and appearance are characteristic. They are very irregular, but there will always be found those of a "T" or "L" shape, which are characteristic of the peanut and resemble true stone cells. Very often

these cells are covered on the outer edge with sharp excrescences like saw teeth. The cells of the inner part of the hypoderm are

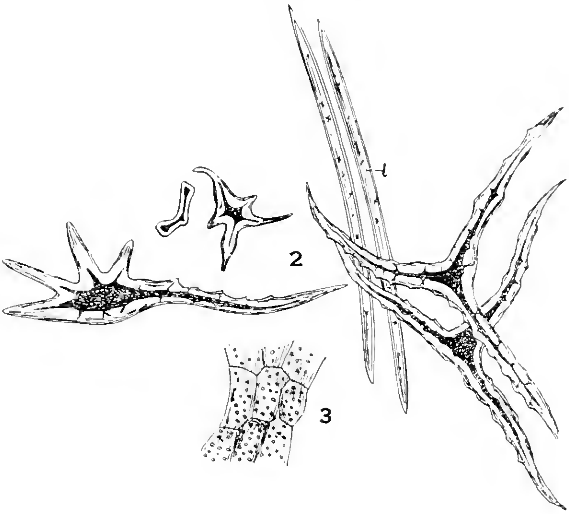

Figure 16

Fig. 16. Peanut. (2) Cells from fibre layer; T and L shaped cells and (1) long fibre cells. (3) Cells from hypoderm.

also characteristic of the peanut. These are roughly rectangular in shape, and their walls are very porous. These porous walled cells are very easily identified in the powdered shells. The starch grains are also a help in the identification. They are spherical in shape and range in size from 5—15μ in diameter; segmented forms are of rare occurrence, and the grains do not occur in aggregates. The laminae in the grains are not visible, but the hilum is central and very distinct, and is seldom cleft. The polarization crosses are not very distinct under ordinary conditions. Fig. 16 shows the elements of the peanut which are useful in its diagnosis.

COTTON SEED.

(*Gossypium, sp.*)

Cotton seed meal has come into prominence as a feed and is sold in bulk as well as mixed with other substances. It has a yellowish color and a characteristic taste and odor which can

usually be detected even when only small quantities of this substance are present in feeds. There are three microscopical characteristics which serve to identify this product. The first is the epidermal layer of cells which are very irregular in shape and size, varying up to 70μ in length. These cells have very thick,

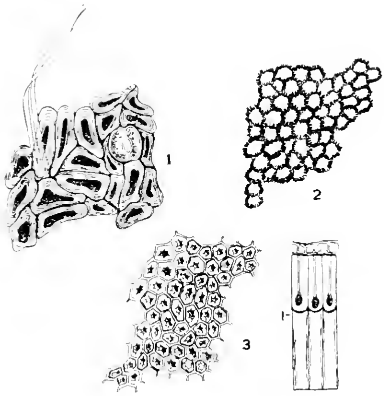

Figure 17

Fig. 17. Cotton seed. (1) Epidermal cells; (2) Colorless "fringe cells" of perisperm. (3) Palisade cells in cross and (1) longitudinal section.

stratified walls of a yellowish color and a deep brown cell content. Hairs with thickened walls and a dark interior are almost always present and aid in the diagnosis.

The palisade cells are next in importance; they have a yellowish brown color and in surface view appear polygonal, giving the tissue a honeycomb appearance. More or less parallel lines cross the cell but are sometimes difficult to see; in diameter these cells are from 10—20μ and have a length of about 150μ.

Covering the embryo is found a thin layer of cells, the walls of which are fringed, giving to the whole the appearance of a network of lace. These are almost colorless and it is sometimes difficult to find them in a sample, but they are highly characteristic of cotton seed. Fig. 17 shows these cells as well as those elements previously discussed.

LINSEED.

(*Linum usitatissimum, L.*)

Ground linseed is used chiefly as a medicine, but the cake left after extracting the oil is used extensively as a cattle food. This

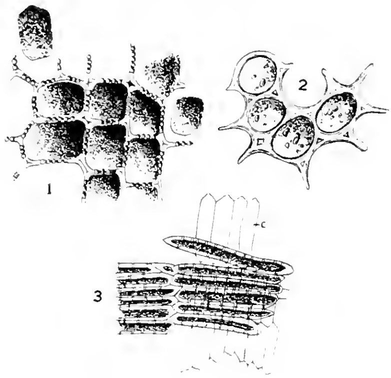

Figure 18

Fig. 18. Linseed. (1) Pigment cells; (2) Round cells of spermoderm; (3) Fibre cells and (c) cross cells.

ground cake is usually gray in color, and possesses a more or less characteristic taste or odor.

There are three characteristics which serve to identify this product. The first is the long, sclerenchymatous cells with pitted walls and a light yellow or straw colored cell content, which are over 100—200μ and have a diameter of from 5—10μ when seen in surface view.

The second characteristic layer of cells is the so-called pigment layer. This layer is made up of more or less square cells, with thick, pitted walls and a brown cell content which in the presence of ferric chloride is stained a deep blue. The round cells of various sizes are also particularly noticeable. These have marked intercellular spaces and are easily recognizable, and are of a light yellow color. The elements of linseed noted are shown in Fig. 18.

SUNFLOWER.

(*Helianthus annus, L.*)

The seeds or achenes, more properly, of sunflower, are found principally in chick feeds, but in foreign countries particularly

the cake left after the extraction of oil has been fed to cattle. The achenes are too well known to need any detailed description; they are obovate, more or less flattened and four sided. In size

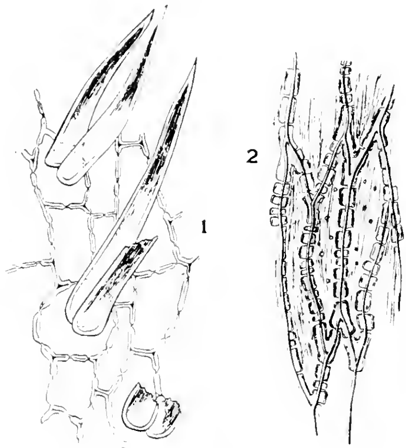

Figure 19

Fig. 19. Sunflower. (1) Epicarp and twin hairs; (2) Cells of fibre layer.

they vary from 4—10 m.m. in length, and are sometimes even longer, and from 3—6 m.m. broad at the top. The color ranges from black to nearly white, usually alternately striped black and white.

The twin hairs are characteristic of sunflower meal, but these are usually broken and hard to find whole. The fibre layer is composed of large cells with pitted walls and pores, and often the cork like layer of cells, called the hypoderm, containing many fine pores, are found. Sunflower meal is not used, however, in this country to any extent. Fig. 19 shows the elements of the achene which are an aid to diagnosis.

OLIVE POMACE.

Olive pomace, a by product in the manufacture of olive oil, has been used to some extent as a cattle food but is of very rare occurrence, in this country at least. If one suspects its presence a sample may be mounted in dilute alkali when the large, irreg-

ular stone cells of the mesocarp will be stained yellow. These cells are so irregular and grotesque as to be characteristic of the

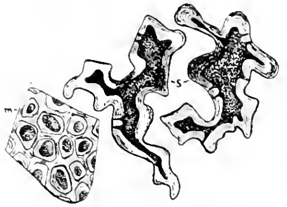

Figure 20

Fig. 20. Olive Pomace. (m) Cells of mesocarp and (s) isolated stone cells from same.

olive. The pigment cells containing a purple coloring matter are stained red with sulphuric acid. Fig. 20 shows the stone cells as well as some of the pigment cells.

CASTOR POMACE.

This substance need not be looked for unless sickness is reported among animals fed, as it is not used as a feed owing to the poisonous principle it contains.

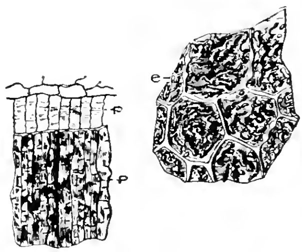

Fig. 21. Castor Pomace. (e) Outer epidermis, surface view, and (p) palisade cells.

It is the residue left after the oil has been expressed from the castor bean. (*Ricinus cmmunis, L.*)

The polygonal cells of the epidermis are pitted and may or may not contain a pigment of a brown color. These cells vary greatly in size. The brown sclerenchymatized palisade cells upwards of 200μ long, with brown walls and distinct pores are also an aid to diagnosis. In surface view the cells are polygonal and about 10—15μ in diameter. Fig. 21 shows these elements.

The seeds of the castor bean are obovoid, flattened somewhat and are irregularly splotched with black or brown, a characteristic appearance of this seed.

PART III.

CHARACTERISTICS AND IDENTIFICATION OF WEED SEEDS AND MISCELLANEOUS PRODUCTS.

CORN COCKLE.

(*Agrostemma Githago, L.*)

This seed is very often found and is objectionable on account of the poisonous substance, *sapotoxin*, which it contains. The seed is roughly kidney shaped (Fig. 22) resembling, as Winton aptly

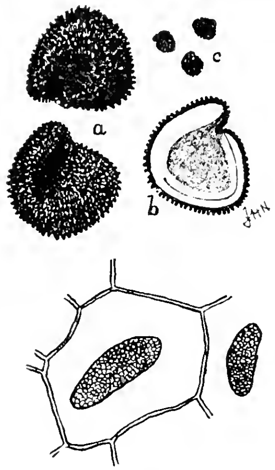

Figure 22

Fig. 22. Corn Cockle. (b) Cross section of epidermal layers and starch masses.

puts it, a rolled up caterpiller. In size it measures from 2—4 m.m. through its greatest diameter, and in color varies from a deep brownish black to a dead black. The surface of the seed is covered with many sinuous folds which to the naked eye seem arranged in parallel rows, especially along the top of the seed. Under the microscope these rows are seen to be made up of a series of convolutions of the outer epidermis. One glance through

a lens at the epidermis is sufficient for the identification of this seed. Another striking characteristic of the cockle is the oval, elongated starch aggregates found in the endosperm. These starch bodies are made up of very minute grains. In size the aggregates vary from 20—100μ in length. (Winton.)

COW HERB.

(*Vaccaria parviflora, Moench.*)

This seed is very rarely found in feeds in this country, but is reported to be of common occurrence in Europe. The seed is spherical in shape with a diameter of from 1.5—2 m.m.; has a dull bluish black color and under the hand lens is seen to be free from papillae on the surface of the epidermal cells.

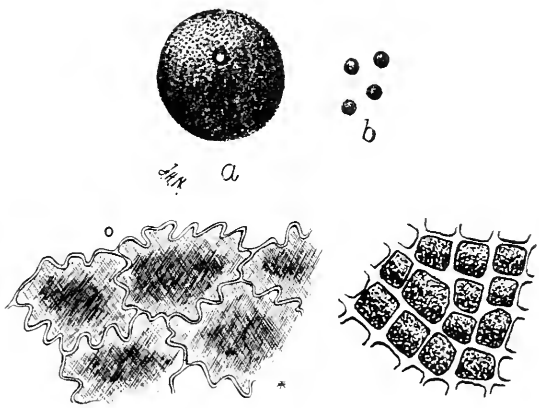

Figure 23

Fig. 23. Cow Herb. (o) Epidermal cells and rectangular cells from near hilum.

The microscopic appearance of the epidermal cells in surface view is characteristic of this seed, they being very regular in outline and saw-toothed, but are smaller than those of *Saponaria officinalis.* The layer of thick walled rectangular cells found near the hilum is also characteristic. The walls of these cells are usually colorless, but the cell content itself is brown in color. They resemble somewhat the pigment cells of linseed but are smaller and not so purely rectangular. (Fig. 23.)

BOUNCING BET.

(Saponaria officinalis, L.)

The seed is flat, somewhat disk-shaped, resembling a lima bean and of a dull black color. In size it varies from 1—2 m.m.

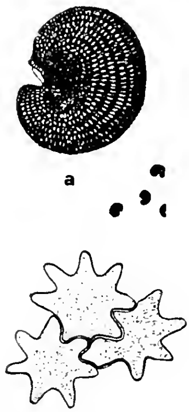

Figure 24
Fig. 24. Bouncing Bet. Epidermal cells.

in length. Under the hand lens the surface is found to be roughened and covered with small papilla-like projections which are arranged in more or less parallel lines along the long axis of the seed.

The appearance of the epidermal cells under the microscope when cleared is the best guide to a correct diagnosis. These cells are large and saw-toothed in outline, with fairly distinct walls, but the interior is clear, containing no dots or other characteristic markings (a distinction from the epidermal cells of catchfly.) (Fig. 24.) This seed is found whole and occasionally somewhat broken, but usually is not ground fine enough to prevent identification.

SPURRY.

(Spergula arvensis, L.)

The seeds of this weed are very often found in concentrated feeds, but are easily recognizable. They are about 1 m.m. broad, circular, and flattened like a discus, and along the edge is a frill

of lighter color. The seed is usually dark brown, dull, with the frill of lighter color, usually more or less straw color.

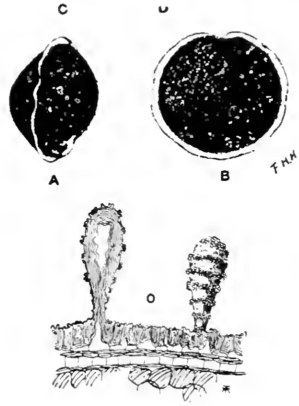

Figure 25
Fig. 25. Spurry. (o) Club shaped bodies of epidermis.

The seed is identified under the microscope by the warty, club-shaped bodies on the epidermis, and the very sinuous epidermal cells. (Fig. 25.)

NIGHT-FLOWERING CATCH-FLY.

(*Silene noctiflora, L.*)

This seed is occasionally found in cattle feeds. Its shape is similar to that of the bean, but much smaller, the maximum

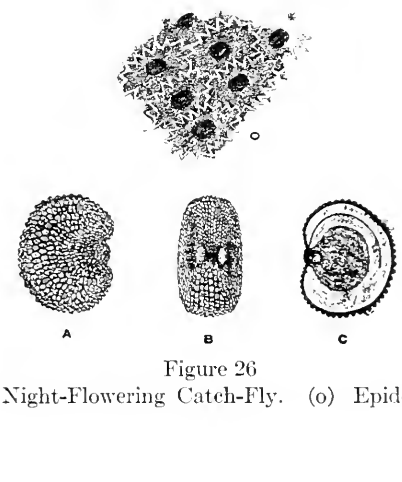

Figure 26
Fig. 26. Night-Flowering Catch-Fly. (o) Epidermal cells.

diameter being only 1.2 m.m. Usually the seed measures about 1 m.m. In color it is dull gray and the surface has many small papilla-like projections.

The epidermal layer of the seed coats is sufficient for its identification. The cells of this layer are very characteristic, being large, roughly polygonal in shape, with a sharp saw-tooth outline. The walls are highly refractive and show distinctly. In the center of each cell there is a rounded protuberance which shows dark under the microscope and gives the roughness to the seed. Besides this large hump there are many small projections which appear as dots under the lens. (Fig. 26.)

MISCELLANEOUS WEED SEEDS.

JIMSON WEED, JAMESTOWN WEED.

(*Datura stramonium, L.*)

This weed occasionally occurs in feeds as an impurity and is very harmful on account of the alkaloid which it contains. It is an easy matter to identify this seed as its external markings are characteristic.

It is from 3—4 m.m. long and from 2—2.75 m.m. broad, in

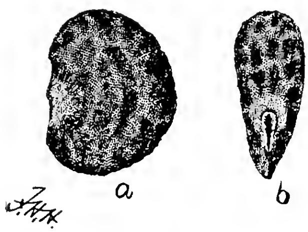

Figure 27
Fig. 27. Jimson Weed.

shape resembling a lima bean. The color of the seed varies from brown to black, and to the naked eye the surface appears to be covered with small depressions of a roughly pentagonal form, giving a wrinkled appearance to the seed. Under the microscope the surface is found to be made up of cells with extremely sinuous outlines and very irregular in size and form. These features are sufficient for a diagnosis of this seed. (Fig. 27.)

ROUGH PIGWEED.

(*Amaranthus sp.?*)

There are several species of this seed found in feed stuffs and as their characteristics are practically the same they will not be differentiated in this work. They are all glossy black in color,

Figure 28
Fig. 28. Rough Pigweed. Epidermal cells.

or glossy brown, if unripe, and double convex in shape, rather more so usually than the lambs-quarters. In size they are usually smaller than lambs-quarters, varying in the different species from .5—1.25 m.m. in diameter. The seeds very rarely exceed the latter size, and the seed envelope is seldom found adhering to the seed.

Under the microscope the surface layer of cells is seen to be polygonal in shape, and ordinarily six-sided, the division lines between the cells being very distinct when the layers are cleared with potash or Javelle water or chloral hydrate. The surface of the cells is covered thickly with very minute projections, much smaller than those of the lambs-quarters, giving a dotted appearance to the surface. (Fig. 28.)

PIGWEED, LAMBS-QUARTERS, GOOSEFOOT.

(*Chenopodium album.*)

This seed is usually found whole, and on account of its similar

characteristics is likely to be confounded with the true pigweeds, which, however, are *Amaranthus*, and not *Chenopodium*.

The seed as found is double convex in shape, and its diameter laterally varies between .75—1.5 m.m. In color it is black and

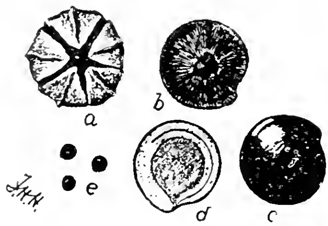

Figure 29
Fig. 29. Lambs-Quarters.

shiny. Very often the seed is found encased in the hull or cover in which it grows. It is then gray in color and of the same general shape as the seed itself. By rubbing between the fingers the covering may be removed and the shiny black seed exposed. The outer seedcoats when cleared and examined under the microscope are seen to be made up of large, roughly rectangular irregular cells which vary in diameter from 25—75μ and which are covered with minute rough projections similar to those of rough pigweed. The size and rectangular shape of the cells distinguish this seed from species of *Amaranthus*.

LADIES' THUMB, SMARTWEED.

(*Polygonum Persicaria, L.*)

This seed is often found in feeds and more especially in chick feeds, and is much like a flattened buckwheat seed having two

Figure 30
Fig. 30. Ladies' Thumb.

faces instead of three; it is from 1—2 m.m. in length and .75—1 m.m. broad, and dark glossy brown to black in color, and very smooth.

The seed coat of *persicaria* differs somewhat from those of others of this family, the surface layer being found in well cleared specimens to have irregular rows of dark dots which are in the middle of the irregular polygonal cells. It is difficult to clear sufficiently to get more details of the cell structure, but this characteristic is sufficient to identify the seed. (Fig. 30.)

HARE'S EAR.

(*Couringia orientalis.*)

In size this seed is from 1.5—2.5 m.m. long and about 1.5 inches in diameter. It is roughly egg shaped with a somewhat

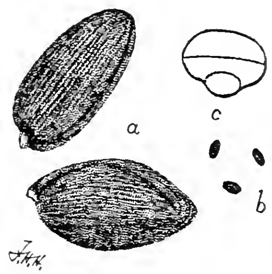

Figure 31
Fig. 31. Hare's Ear.

depressed pointed end, and a more or less pronounced ridge along the back of the seed and a slight depression on the ventral side. In color it varies from light to dark brown, with a greyish tinge sometimes not noticeable. The surface is covered with very small projections which give a slightly roughened appearance to the surface. Under the hand lens these projections appear to be in more or less parallel rows. (Fig. 31)

PEPPER GRASS.

(*Lepidium Virginicum, L.*)

This seed is small, flattened and ham-shaped, of a rusty brown color and in size from 1—2 m.m. in length and from .5—1 m.m. in width. Along the edge of the seed is usually found a thin pro-

nounced membraneous ruffle which is easily seen with a hand lens and is usually visible to the naked eye.

The only microscopic characteristic of value in identifica-

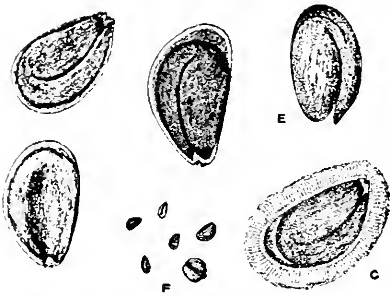

Figure 32
Fig. 32. Pepper Grass.

tion are the mucilage cells, which on the addition of water burst, and the cell contents from a column broadened at the top. (Fig. 32.)

SHEEP SORREL.

(*Rumex acetosella, L.*)

The seed is shaped like that of buckwheat but is not nearly so large, measuring only 1—1.5 m.m. in length. The color of

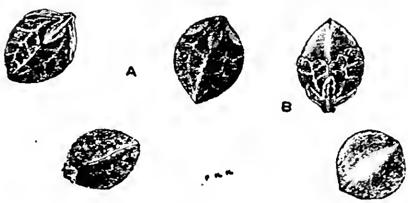

Figure 33
Fig. 33. Sheep Sorrel.

the seed is a dull reddish brown. The surface shows rough under the hand lens, being covered with a number of small ridges and projections. The epidermal layer is highly characteristic, being made up of irregularly strongly convoluted small cells which give the rough appearance to the seed. The ridges formed by these convolutions are more or less parallel. (Fig. 33.)

CURLED DOCK.

(*Rumex crispus, L.*)

The seed of the curled dock is slightly larger than that of the sorrel, having a length of from 1.5—2 m.m. The color is a

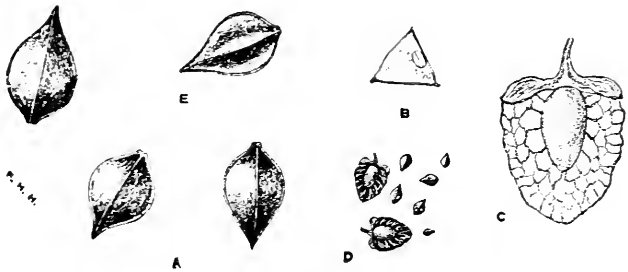

Figure 34
Fig. 34. Curled Dock.

beautiful glossy reddish brown to brown; in shape the seed resembles that of buckwheat but is proportionately broader at the base.

It is usually found whole in feeds. The seed coats are very difficult to clear sufficiently to see the cell structure, but in well cleared specimens the surface layer is found to be made up of irregular cells with sinuous walls which are well defined and nearly clear. The cells are much larger than those of the sorrel. (Fig. 34.)

CHARLOCK.

(*Brassica arvensis, L.*)

This seed is very abundant, and is found in quantity in wheat screenings, as well as an impurity in other cattle feeds. It is a deep brown to dull black in color and nearly spherical in shape, and the surface is almost *smooth*, showing practically no roughness, even under the hand lens. In size the seed varies from 1—1.5 m.m. in diameter, being smaller than rape.

The epidermal layer and the single layer of palisade cells, containing a dark brown substance are the chief aids to a correct diagnosis.

The epidermal cells average 60μ in diameter and contain a mucilaginous deposit, which when the cross section is mounted

in alcohol and treated with water, is seen to have a characteristic radial appearance, much like the ribs of an umbrella. The water must be carefully added or this will not be seen.

The palisade cells are of a deep brown color and this is changed

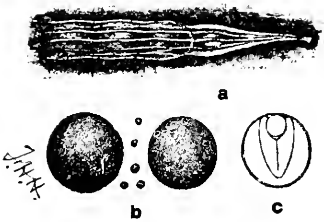

Figure 35
Fig. 35. Charlock.

to a blood red when cross sections are heated slightly with a solution of chloral hydrate. This reaction is characteristic of charlock. (Fig. 35.)

RIB GRASS.

(*Plantago lanceolata, L.*)

The seeds of rib grass as well as of other species of plaintain are very often found in the examination of foods, but each is so different in structure that by the use of a hand lens it is very easy to identify them. The seed of *Plantago lanceolata* is shaped like a double ended canoe. In length the seed varies from 1.5—2.5 m.m., seldom, however, reaching the latter size. In color

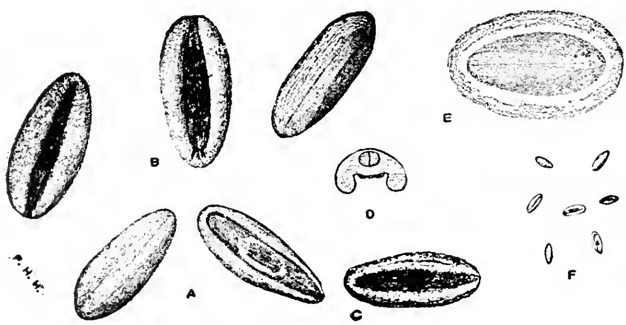

Figure 36
Fig. 36. Rib Grass.

the seed varies from dark, shiny brown to black and has no transverse depression. The cotyledons are right and left of the perpendicular axis of the seed. The surface of this variety is smooth, and has very few mucilage cells in evidence. Fig. 36 shows the rib grass seed and the elements of use in its diagnosis.

BRACTED PLANTAIN.

(*Plantago aristata, L.*)

The seeds of this plantain are somewhat larger than those of *Plantago lanceolata*, but are very similar in shape; i.e., canoe shaped, but are broader and flatter. They vary in length from 2—32 m.m. and on the concave side are distinctly marked with a concentric ring of light color, enclosing an inner portion of whitish color. The seeds are light brown in color, and the convex side which is usually darker in color is marked with a slight transverse depression that is barely distinguishable to the naked eye, but is very easily seen under the hand lens. The surface is covered with mucilage cells which, when swollen with water,

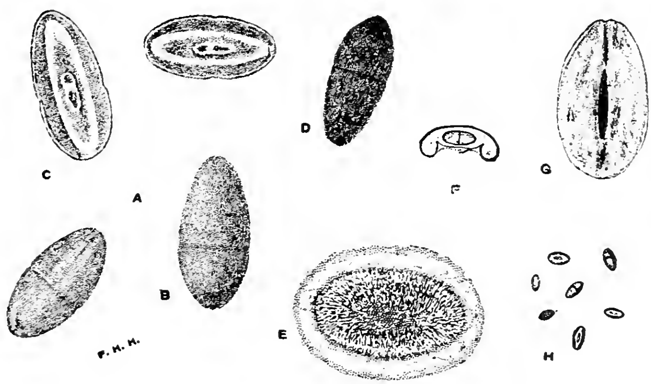

Figure 37
Fig. 37. Bracted Plantain.

are of the "open S" or hour glass type. The cotyledons are right and left with respect to the central axis, but are broader than those of the rib grass. Fig. 37 shows the bracted plantain and some of its elements.

RUGEL'S PLANTAIN.

(*Plantago Rugelii.*)

The seeds are dark brown to black, varying in length from 1.25—2.5 m.m. They are slightly flattened with sharp angles,

Figure 38
Fig. 38. Rugel's Plantain.

and vary in shape from oval oblong to rhomboidal. The surface of the seed is minutely roughened and dull, but with no ridge or lines as in *P. major*. The cotyledons have the ventral and dorsal position in the seed. The epidermal layer consists of rectangular cells arranged in rows, which, however, are not continuous or parallel as in *P. major*. This seed greatly resembles *P. major* but is slightly larger. (Fig. 38.)

GREEN FOXTAIL.

(*Chaetochloa viridis, L.*)

YELLOW FOXTAIL.

(*Chaetochloa glauca, L.*)

The seeds of these two varieties are different in size, although both have the same general appearance. The seeds of both are flat on the palet side and very convex on the other. In size they vary from 2—3 m.m. in length and from 1.5—2 m.m. in width. The seeds of the yellow foxtail are usually somewhat larger and less convex than those of the green, and the color of the ripe fruit is somewhat different. *Glauca* is greenish yellow in color, while *viridis* is from pale green to light brown in color.

The histological characteristics of the foxtails are almost identical and it is extremely difficult to separate the two varieties when they occur in ground condition.

Under the hand lens it is easily seen that the transverse wrinkles on the glume of *glauca* are much more prominent than those on *viridis* owing to their being further apart.

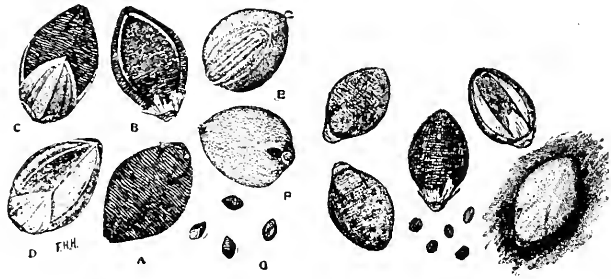

Figure 39
Fig. 39. Green and Yellow Foxtail.

The glumes are the chief means of identification, and closely envelop the grain when ripe. The cells in surface view are thick walled, with very sinuous side walls and the end walls also are usually sinuous. They are arranged in longitudinal rows and to some extent in transverse rows as well.

The folds of the cell walls are very regular. In size and shape the cells vary somewhat, depending whether they are taken from the middle or edge of the glume, but are usually from once and a half to twice as long as broad.

Usually, however, the seeds occur whole, and a glance at them under a hand lens is sufficient for their identification. (Fig. 39.)

ALFALFA.

Occasionally the seeds of alfalfa are found as an impurity in some cattle feeds, principally those containing wheat, but lately chopped alfalfa hay is used in some feeds. It is usually chopped fine and may be recognized by its green color and odor. Usually it is not necessary to make a microscopic examination of the specimen, as the characteristic odor and color are the best indications of its presence.

COCOA SHELLS.

These are used in a number of ways in commerce, and are often found in cattle feeds as well as in human foods.

There are three microscopical characteristics which are to be depended on in diagnosing this product, and these are (1) the stone

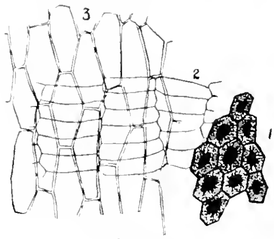

Fig 40

Fig. 40. Cocoa shells. (1) Stone cells; (2) Cross cells of endocarp and (3) epidermal cells.

cells; (2) the cross cells of the endocarp and (3) the large, strongly walled cells of the epidermis.

The stone cells are, in surface view, elongated polygonal in shape, having a characteristic dark interior and thick, lighter walls. The cells vary from 15 to 25μ in length and the cell walls vary from 3—5μ in thickness.

The cross cells are more or less characteristic, also. This layer of cells runs transversely around the seed and are longitudinally parallel. They are from 10—15μ in width and about 200μ long, or sometimes more.

The cells of the epidermis are large, polygonal in shape and have distinct walls; in size they are from 40—50μ in width and about 150—200μ in length. In order to clearly see these cells the specimen should be treated with Javelle water.

The ground shells have in bulk a peculiar, almost greasy brown color, quite characteristic of this product. Fig. 40 shows the elements of aid to a diagnosis.

SUGAR BEET PULP.

This pulp is coming into prominence as a cattle food and is sometimes found in mixtures. In bulk the pulp is whitish grey, with a sweetish odor and somewhat mealy taste.

Under the microscope the only two characteristics which serve as an aid to its identification are the large, irregularly polygonal cells of the parenchyma which have walls from 3—5μ in width, and the cells sometimes reach a length of 300μ but are

more commonly about 200μ. Numerous intercellular spaces are found in carefully mounted slides.

Many reticulated vessels are also noticeable; these have an average diameter of from $50—80\mu$ although occasionally wider

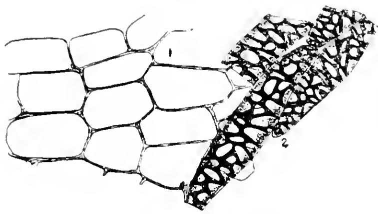

Figure 41

Fig. 41. Sugar beet pulp. (1) Parenchyma cells and (2) reticulated vessels.

ones are found. The reticulations are large and irregular in shape, giving the vessels the appearance of a sieve. In length the vessels vary greatly, and are very seldom found entire in materials. Fig. 41 shows these elements.

PART IV.

CHARACTERISTICS AND IDENTIFICATION OF CONDIMENTS.

ASFAETIDA.

(*Ferula foetida and spp.*)

This substance is a gum-like resin in its natural state and occurs in some condimentals. When seen under the microscope it appears as irregular greyish masses streaked with brown and these are semi-lustrous. There is no certain microscopical method of diagnosis, but the substance is best detected by its characteristic alliaceous odor which is very persistent, and by its bitter taste. When triturated with water the gum yields a milky emulsion.

ANISE.

(*Pimpinella Anisum, L.*)

This is occasionally found in cattle foods of a condimental nature, and is used to flavor them and give an agreeable odor,

also to mildly excite the action of the stomach. It has a warm taste and an agreeable characteristic odor which is an aid in its diagnosis.

The peculiar warty hairs of the epidermis and the large, more or less branching oil ducts are highly characteristic of anise. (Fig. 42.) The hairs are up to 200μ in length and about 15μ broad, and have minute protuberances on the surface. The base is more or less polygonal in shape and similar to the brownish epidermal cells. Occasionally the hairs are divided by a cross partition.

The oil ducts are of various sizes and range in diameter from 10—150μ. They are very numerous and as a rule can be easily found and are usually branched to a certain extent. They are found in the mesocarp, or the layers of cells directly underneath

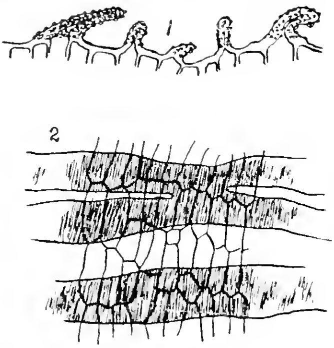

Figure 42

Fig. 42. Anise. (1) Warty hairs from epidermis, and (2) oil ducts.

the surface layer. The odor of anise is a great help in its diagnosis.

BLOOD ROOT.

(*Sanguinaria canadensis.*)

This drug is occasionally found in condimentals and is usually in powdered condition, but unless present in a reasonable quantity is extremely hard to identify. It has no odor practically, but the taste is striking, being very bitter and acrid. The powder is of a reddish color on account of the number of reddish pigment cells it contains. None of the cells contain calcium oxalate crystals,

but starch grains are present and are spherical in shape, ranging in size from 4—8μ in diameter. The taste and color are about the best methods of identification.

CARAWAY.

(*Carum Carvi, L.*)

The residue from the manufacture of caraway oil is sometimes used as a cattle food and the fruit, either whole or ground, is used in condimentals to a certain extent. The whole fruit resembles fennel somewhat except that in cross section the pentagons are more nearly equilateral, the inner surface being about the same width as the four exposed sides. In structure it also resembles fennel, with a few differences; among which may be mentioned the absence of brown polygonal parenchyma cells and reticulated cells which are characteristic of fennel. The oil ducts are much larger in caraway than in fennel, sometimes reaching 300μ or more in diameter. Isodiametric sclerenchyma cells are also found in caraway and not in fennel. The endocarp cells are broader and transversely arranged and are never parqueted as in fennel.

The odor and taste are agreeable and are of great aid in the identification. Both are more or less characteristic, but are not so strong as anise or other members of this group.

CAPSICUM (PEPPER).

(*Capsicum spp.*)

This spice is very often found in condimentals and to a much less extent in foods. The ground fragments are usually large enough to be seen with a hand lens and are often red in color. The fragments have a characteristic, burning, biting, taste which is familiar to everyone, and the powder when inhaled irritates the nasal passages and induces sneezing.

The cells of the epicarp, or the epidermis are the best means of identification microscopically. These are quadrilateral cells approximately 30—50μ in diameter, with double walls about 4μ thick. The walls are more or less wavy in outline, but the cells themselves are arranged in longitudinal rows, differing in this way from other varieties. Another feature of considerable use in diagnosing this spice are the epidermal cells of the spermo-

derm. These cells are sinuous, with strongly convoluted walls,

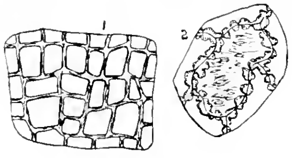

Figure 43

Fig. 43. Capsicum. (1) Epidermal cells of epicarp and (2) cells of spermoderm.

resembling, as Moeller has it, tripe. These elements are shown in Fig. 43.

CASCARA SAGRADA.

(*Rhamnus Purshiana.*)

This drug is sometimes found in condimentals and may best be recognized by one familiar with it, by its distinctive odor and bitter, acrid taste. The powder is light brown in color. Among the elements will be found very long, thick, liquified bast fibres, as well as roughly rectangular stone cells about 50μ in diameter, with thick walls; and both monoclinic crystals and rosette aggregates of calcium oxalate. Another layer of cells of interest is the parenchyma layer, the cells of which contain a yellowish substance which is colored red with alkalis.

CORIANDER.

(*Coriandrum sativum.*)

The coriander fruit is used both whole and ground, and acts as a flavoring substance chiefly, although it may have some little tonic effect on the digestive juices. It has a mild and pleasing odor and flavor, somewhat resembling that of fennel but not so pronounced. While most of the tissues resemble those of fennel, celery and other fruits of this family, the layer of fibre cells, which cross each other and form a layer from 50—175μ thick, are characteristic. These fibres have thick sclerenchymatized, porous walls and are easily recognized. Usually also will be found portions of the oil ducts, which with the fibre layer are of aid in the diagnosis. These oil ducts are from 300—400μ in diameter. In bulk the powdered coriander is light brown in color.

CURCUMA.

(*Curcuma longa.*)

Curcuma or turmeric is used as a coloring matter and also as a spice in foods. It is closely related to ginger and has a characteristic pungent taste. None of the elements, with the exception of the starch grains and their reactions, are of use in its identification, but these are found in both normal and altered condition; the broken down starch grains sometimes filling the whole cell. The starch lumps are yellow and become red brown with alkali; also if a drop of sulphuric acid is introduced on the slide a crimson

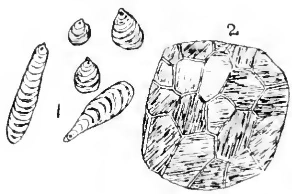

Figure 44

Fig. 44. Curcuma. (1) Unaltered starch grains and (2) polygonal corky cells.

color is seen. Fig. 44 shows the starch masses as usually found and some unaltered grains, also the polygonal layer of cork cells, which, however, are not characteristic of curcuma.

ELECAMPANE.

(*Inula Helenium.*)

This substance occurs as a yellowish brown powder, but has few elements of use in its diagnosis. It is best recognized by its aromatic odor, and bitter acrid taste.

FENNEL.

(*Foeniculum capillaceum.*)

The seeds of this spice are sometimes found whole in foods, but as a rule the refuse from the manufacture of the essential oil is used to feed to cattle.

The whole seed is made up of two carpels; flat on the contact surfaces and with five distinct ribs running longitudinally the length of the seed. The carpel is roughly canoe-shaped, and curves concavely on the contact surface on long drying. In

length the seed is from 5—10 m.m. long and from 1—2 m.m. broad. The crushed seeds have a characteristic taste and odor.

Aside from the taste there are few characteristics of the tissues which are useful in diagnosing the seed.

GENTIAN.

(*Gentiana lutea.*)

This powder is brownish in color and has a characteristic bitter taste and odor. The cells contain no oxalate crystals and no root hairs are present. Usually small cells with broken walls and having numerous oblique pores are found. The odor is sufficient to identify this drug. It is, however, of very rare occurrence.

GINGER.

(*Zingiber officinale.*)

There are several varieties of ginger in use at present, both as a spice and drug, and these are sometimes used in certain feeds, but ginger is not of common occurrence. When found it is usually in a ground state and the fragments have a few characteristics which serve as a means of identification for this spice. Of primary importance are the characteristic starch grains which in the case of the ordinary ginger are irregular in shape, somewhat resembling curcuma but very much smaller. They are flattened ovate and generally have an angled or sharp point at the narrow end which is quite distinct. The excentric hilum is always within the angle and is distinctly visible. The grains have many laminae which are sometimes visible and sometimes not, as the case may be. Usually the grains are found singly, although in some varieties aggregates of two or three grains may occur. In size the grains range between 20—30μ through their longest diameter, although smaller grains may occur and occasionally some ranging a little larger than 30μ.

In addition to the starch grains the bast fibres are of use in diagnosing this substance. These are very flat, broad, long vessels with thin walls and sometimes reach a length of 3—5 m.m. and a width of approximately 50μ. The cell walls have pores which are usually crossed with diagonal clefts.

The reticulated vessels occurring in connection with the bast fibres are also a help to recognition. These are long and rounded

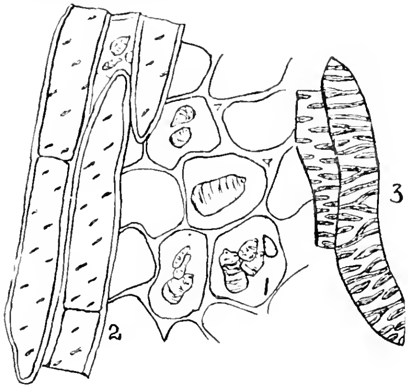

Figure 45

Fig. 45. Ginger. (1) Starch grains; (2) Bast fibres and (3) reticulated vessels.

in cross section, usually have pointed ends, and vary more in size than do the bast fibres. (Fig. 45.)

LICORICE.

(*Glycyrrhiza glabra and var.*)

Licorice is said to occur sometimes in condimentals and when found in any quantity may be recognized by the odor and taste which is quite characteristic. There are, however, no particular cell characteristics which would be of aid to a rapid diagnosis. The color of the powder is light yellow, with a somewhat sweetish odor and slightly acrid taste. This substance is not of general occurrence, however. In addition to variety *glabra* there are other varieties used which differ somewhat in structure and composition, the details of which are unnecessary to the diagnosis. The appearance, odor and taste are the best aids to the diagnosis of this product when found in condimentals or condition powders.

LOBELIA.

(*Lobelia inflata.*)

This drug is made up of the ground stem, top leaves and flowers of the plant. In color the powder is dark green and pos-

sesses a characteristic acrid taste when held in the mouth for a short time. Under the microscope are found large, one-celled

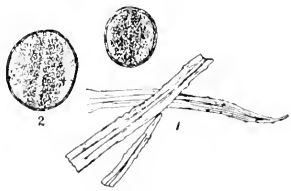

Figure 46
Fig. 46. Lobelia. (1) Unicellular hairs and (2) Pollen grains.

hairs with thick walls from 0.3—0.6 m.m. in length; spiral ducts, but no oxalate crystals are present. Frequently smooth ellipsoidal pollen grains from 15—30μ in diameter are found. The elements noted are shown in Fig. 46. By means of the color and taste the diagnosis of this drug is made comparatively easy.

MAY APPLE.

(*Podophyllus peltatum.*)

The powder of this drug is occasionally found in condimentals but is rather hard to distinguish as there are no especially characteristic tissues that aid in the diagnosis. The drug has scarcely any odor, in color is usually a light yellow or whitish, and possesses a bitter acrid taste. It is used occasionally as a purgative or tonic, and is usually present only in small quantities.

NUX VOMICA.

(*Strychnos Ignatic*) (*S. nux vomica.*)

The powdered drug is grayish white in color but does not possess any great odor; the taste is intensely and persistently bitter. The epidermal cells are modified so that they resemble strongly lignified hairs. No calcium oxalate crystals are found in the powder. The oil cells are thick walled and finely porous. If on examination the presence of this drug is suspected, a sample may be treated with potassium chromate and sulphuric acid, when the endosperm cells will be stained blue or violet. Occasionally very small spherical starch grains occur, which, however,

are not characteristic. Fig. 47 shows the elements of aid in the diagnosis of this drug.

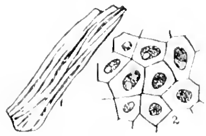

Figure 47
Fig. 47. Nux Vomica. (1) Epidermal cells and (2) Oil cells.

OAK BARK.

(*Quercus alba.*)

White oak bark is occasionally used as a drug and occurs as a light brown powder, of no particular odor, but having a somewhat characteristic astringent taste. One or two elements of the powder are useful in its diagnosis. Long, thick walled lignified bast fibres are found, and also crystal cells containing rosettes or monoclinic prisms of calcium oxalate about 10—20μ.in diameter. There are also found thick walled stone cells with numerous lamellae and simple pores. The parenchyma, while not characteristic, contains irregularly shaped brownish tannin masses. The characters noted above will be found illustrated in Fig. 48.

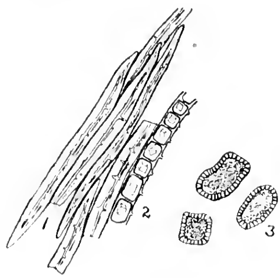

Figure 48
Fig. 48. Oak Bark. (1) Bast fibres; (2) Crystal cells and (3) stone cells.

SASSAFRAS.

(*Sassafras officinale.*)

This powdered drug is light brown in color, and possesses a characteristic aromatic odor, and has an astringent, aromatic, somewhat mucilaginous taste. Its presence can usually be detected by these characteristics when present in any quantity.

Under the microscope are found thick walled, lignified bast fibres, which are not usually found in aggregates. Single starch grains

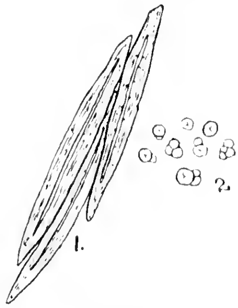

Figure 49
Fig. 49. Sassafras. (1) Lignified bast fibres; (2) Starch grains.

and aggregates of two or three are often found, the grains ranging in size from 7—20μ. Irregular masses of tannin are found in the parenchyma tissue, and usually there are numerous oil globules present. Fig. 49 shows the elements of sassafras which are an aid to its diagnosis when found in condimentals.

SENNA.

(*Cassia spp.*)

This drug is sometimes found in condimentals. In bulk the powder has a greenish color and a characteristic bitter taste.

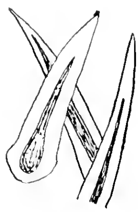

Figure 50
Fig. 50. Senna. Non secretion hairs from leaf.

Under the microscope are usually found numerous non-secretion hairs from the under side of the leaf. These are quite characteristic and vary in length from 0.1—0.2 m.m.; are pointed, broadly awl shaped with distinct walls, and are unicellular. Fragments of the powder become reddish in color upon the addition of alkali. Calcium oxalate crystals are found which are both rosette shaped and in monoclinic prisms from 10—35μ in length. (Fig. 50.)

There are other substances which are sometimes used as condimentals, but which cannot be taken up at this time. Some of them are placed in other parts of this bulletin, where it is thought they more properly belong.

A few, which have been reported rarely, have been left out, as it is believed that they are of little importance.

PART V.

IDENTIFICATION OF CHEMICALS AND MISCELLANEOUS SUBSTANCES.

ALUM.

Alum is sometimes added to the so-called condimental stock-foods and if present is usually in sufficient quantity to be easily detected by its characteristic taste. This cannot be easily described, but is more or less acid and bitter, and when touched to the tongue "puckers" the skin at that point. If alum is suspected but cannot be positively identified by the taste, the following test may be used. A portion of the sample, or particles thought to be alum, may be shaken up with 10 c.c. of water in a test tube, and 1 c.c. of an alcoholic tincture of logwood added (5 gm. logwood digested in 100 c.c. alcohol), then 1 c.c. of a saturated solution of ammonium carbonate added, and the whole shaken for some time. If alum is present the mixture will have a decided lavender blue color, which will remain for some time. This method is applicable to cattle foods and gives a good indication as to its presence or absence in condimentals. The presence of alum, is, however, not a usual thing in foods.

ARSENIC.

This substance has been reported in certain foods, but has never been found by the author. Its presence or absence may be detected by the well known "Marsh Test", a description of which may be found in any good analytical work. The chemical analysis will usually reveal its presence. It is of very rare occurrence in condimentals.

ANTIMONY.

This has also been reported in foods, but has never come under our observation. As a certain amount of organic matter does not interfere with the "Marsh Test", it can be tested for, by that method, the difference between arsenic and antimony being that the arsenic mirror dissolves in sodium hypochlorite, and the antimony mirror does not. This substance is also of rare occurrence in condimentals.

CALCIUM CARBONATE.

The particles of this substance, when it is found in stock foods, are usually large enough to be picked out with the forceps. They are white in color and do not possess any particular taste or odor. Small particles of the suspected substance may be picked out and placed on a slide containing a couple of drops of water. A drop of dilute hydrochloric acid is added from a stirring rod and an effervescence of carbon dioxid indicates the presence of calcium carbonate. If it is necessary to prove calcium present, the same solution is rendered alkaline with ammonia and a small amount of ammonium oxalate is added. A white cloudiness or precipitate indicates calcium. As a confirmatory test for calcium, a small particle may be held in a colorless flame; calcium is indicated in the absence of other compounds by the yellowish red color imparted to the flame.

CALCIUM PHOSPHATE.

If the presence of this substance is suspected, a little of it may be mounted in glycerine on the slide and small tetragonal and cubical crystals are sometimes observed. When the suspected crystals are treated with a little nitric acid (dilute) and then a few drops of ammonium molybdate solution are added, diamond shaped yellow crystals of small size may be obtained, or at least a yellow color will be observed.

CHARCOAL.

Charcoal very often occurs in stock and chick feeds. It is used partly as an absorbent for the odors arising from the other constituents. In stock feeds it is usually ground fine, but in

chick feeds it is very often found in particles large enough to be easily picked out. When a piece of charcoal is rubbed along the surface of a white paper it gives a black smear, and this is the quickest way to identify it. Under the microscope the particles of charcoal appear black and are not cleared by ordinary reagents. Charcoal is not bleached by either aqua regia or any other bleaching-agent.

GLAUBERS AND EPSOM SALTS.

These are often met with in condimentals but no accurate method may be given for their identification microscopically. Slide tests may be made, when their presence is suspected, for sulfates of sodium or magnesium, but this may be shown better by a chemical examination. The particles of these salts are colorless and have a peculiar cooling taste somewhat characteristic. They are used as purgatives in condiments.

IRON SULPHATE.

Copperas (iron sulphate) sometimes occurs in cattle foods, more especially in the condimentals. The particles are usually coarsely ground and are large enough to be picked out. They are pale green or brownish (if oxidized) in color and may be treated on the slide as in the case of calcium, using barium chloride as a reagent. A white or milky precipitate indicates sulphuric acid; the iron is usually detected in the chemical analysis and is rather hard to identify microscopically.

IRON OXIDE.

Iron oxide (Venetian red) is also sometimes found in finely pulverized condition. It is used as a coloring matter in the foods and is easily recognized by its characteristic red color.

Iron oxide (Princess metallic) is also occasionally found in foods. Its identification is the same as that for the previously mentioned oxide of iron. Both of these substances are dry paints and have no medicinal value, being used simply as covers for other substances and to give color to the mixture.

POTASSIUM NITRATE.

Potassium nitrate (saltpetre, nitre) is frequently found in condimental foods; it is a white, finely crystalline salt, and is best detected by its characteristic taste. The taste of this salt may best be described as slightly bitter and cooling to the tongue. In medicine it is used to excite the action of the kidneys and to keep down fever.

ROSIN.

Rosin occurs occasionally in foods and may be identified by its odor when rubbed between the fingers. The small particles are of an amber brown color, and when ground become light-yellowish in color. On a slide particles of rosin may be identified by the addition of a little 75% alcoholic tincture of alkanna root. After a short time the rosin is stained a beautiful red. It has no medicinal value, but is used in the substance as a filler.

SALT.

Common salt is very often found in cattle foods in varying amounts from 1—30%. It is easily detected by its taste. It occurs as small crystals, colorless or white, and can usually be picked out with the forceps. Micro-chemically it may be identified by placing a few of the suspected crystals in a drop of water on a slide and adding a drop of silver nitrate solution. A white precipitate shows the presence of chlorine, and may be taken as proof that it is there as sodium chloride or salt.

SULPHUR.

Sulphur is sometimes present in a few of the condimentals, and may be recognized by its characteristic lemon-yellow color and by the odor of the oxide fumes when a portion of the sample is ignited. It is usually present as a fine powder.

If the chemical analysis of a food gives an abnormally high fat content, the presence of free sulphur is to be suspected and the sample is examined as directed. Its object in a condimental appears to be that of a mild laxative.

SAND.

Sand is used in commercial foods as a filler, and can be easily distinguished from other gritty substances by its color. While

ground shells are white or pearly in color, sand, under the microscope varies from white through various shades of pink, red, brown and yellow. The edges of the particles are not usually so sharply defined as in the case of clam or oyster shells. If there is any doubt as to whether the substance under examination is sand or shells a drop of hydrochloric acid may be introduced on the slide and in the case of sand, no effervescence takes place, such as occurs when ground shells are treated with this reagent. The particles of sand are also as a rule much smaller than those of shells.

CLAM SHELLS, OYSTER SHELLS.

Ground clam and oyster shells are very often found in chick feeds as well as in other commercial feeds. The particles are large enough to be seen with the naked eye and are white or pearly in color with a decided lustre. Under the microscope they may be distinguished from ground fragments of bone by the absence of the characteristic bone structure, and show no lacunae or any canaliculi. They also give off carbon dioxid more abundantly than do the fragments of bone when a drop of hydrochloric acid is introduced under the cover glass.

BONE MEAL.

Fragments of bone meal may be recognized by the characteris-

Figure 51

Fig. 51. Bone meal. Showing lacumae and canaliculi.

tic lacunae and canaliculi of the bone tissue when cleared and examined under the microscope with a low power lens. It also gives off a little carbon dioxid on the addition of hydrochloric acid. (Fig. 51.)

DRIED BLOOD.

This substance, when it occurs in feeds, appears to the naked eye to be made up of irregular black lumps, small in size, which

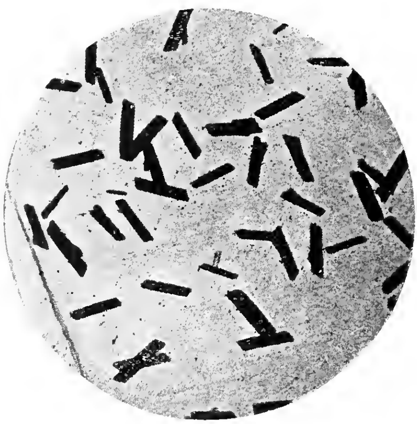

Figure 52
Fig. 52. Dried Blood. Hemin crystals.

are rather hard to crush in dry condition. Its presence may be confirmed by the so-called hematin test.(3) This is made as follows:—

The material is placed on a slide with a little water to which a small crystal of sodium chloride has been added; the solution is then allowed to evaporate until nearly dry and a cover slip put on. A few drops of glacial acetic acid are then introduced under the slide and the whole heated on a radiator for three or four minutes, adding acid from time to time;— then the slide is removed and slowly cooled. If sufficient care has been used small plate crystals of the substance will be found on the slide. These indicate the presence of blood. (Fig. 52.)

3 U. S. Dept. Agr. Bur. of Chem., Bul. 108, p. 78. Figs 51 and 52 are reproduced from this bulletin.

ANIMAL MEAL.

The presence of animal meal or tankage can be easily confirmed by clearing a portion of the suspected substance by means of chloral hydrate and observing the characteristic striated muscle fibre, which is always present in abundance. The characteristic odor of animal meal also helps a great deal in its diagnosis.

ANALYTICAL KEY TO SOME COMMONLY OCCURRING STARCHES.

The key which follows is not entirely original with the author; it is more a compilation of the keys found in Winton's "Microscopy of Vegetable Foods," Leach's "Food Inspection and Analysis" and Moeller's "Mikroskopie der Nahrung-und Genussmittel", but as all these books are not usually available it has been thought advisable to prepare a key which shall be brief, accurate and contain the salient points of difference in the starches. The author has differed in a few instances from the results of other investigators, but only after the closest examination into the points of difference.

The first principal difference in starches being their shape, they have been classed in this key under five general heads, viz., polygonal, spherical, circular, ellipsoidal and irregular grains, the last class containing all those starches which do not fall strictly under the head of the four former divisions. The starches under each division are then arranged according to their descending sizes, and under these their particular characteristics are given.

This table is of use principally to those who are more or less familiar with the microscopical appearance of the starches, for as its name implies, it is simply an analytical key for their recognition.

The measurements have been given in microns (μ) instead of decimal parts of a millimeter, it being more common to use this unit of measurement in this connection. A μ equals 1-1000 millimeter or 0.001.

I. POLYGONAL GRAINS.

A. . . . . Corn (Maize).

1. *Size.* Grains usually 15—25μ in diameter. (Very few smaller.)
2. *Form.* Sphaero-polygonal or sharply polygonal.
   a. Compact aggregates not present.
3. *Laminae* (rings). Not visible.
4. *Hilum.* Central,—very distinct.
   a. Often with radiating clefts.
5. *Polarization Crosses.* Brilliant, distinct crosses.
6. *Selenite Plate.* Indifferent play of colors.

B. . . . . BUCKWHEAT.

1. *Size.* Grains usually 5—12μ in diameter.
2. *Form.* Sharply polygonal or sphaero-polygonal, more often.
   a. Angular aggregates or rod-like aggregates usually present.
3. *Laminae.* Not visible.
4. *Hilum.* Very distinct.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Indifferent play of colors.

C. . . . . OATS.

1. *Size.* Grains usually 5—8μ in diameter. (Very seldom larger).
2. *Form.* Well defined polygons.
   a. Spindle-shaped single grains also occur. (Characteristic of oat starch.)
   b. Rounded aggregates often occur.
3. *Laminae.* Not visible.
4. *Hilum.* Absent.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Indifferent play of colors.

D. . . . . RICE.

1. *Size.* Grains commonly 2—7μ in diameter. (Rarely larger).

2. *Form.* Sharply polygonal, occasionally sphaero-polygonal.
    a. Rounded ellipsoidal aggregates of usual occurrence.
3. *Laminae.* Not evident.
4. *Hilum.* Central. (Not always evident.)
5. *Polarization Crosses.* Brilliant, distinct crosses.
6. *Selenite Plate.* No play of colors.

II. SPHERICAL AND SEGMENTED-SPHERICAL GRAINS.

A. . . . . SWEET POTATO.

1. *Size.* Grains are of two sizes, the larger 25—40μ, the smaller 5—15μ in diameter.
2. *Form.* Spherical, with one or two flat sides.
3. *Laminae.* Indistinct or lacking.
4. *Hilum.* Distinct, excentric.
    a. Excentricity about one-half.
5. *Polarization Crosses.* Very distinct, brilliant.
6. *Selenite Plate.* Indifferent play of color.

B. . . . . CASSAVA.

1. *Size.* Grains from 12—20μ in diameter, (seldom reaching 35μ.)
2. *Form.* Segmented-spherical. (Kettle-drum shaped.)
    a. Spherical grains rare.
    b. One or two flat sides common, over two rare.
    c. Aggregates of two to five grains sometimes found.
3. *Laminae.* Very indistinct or lacking.
4. *Hilum.* Central, very distinct.
    a. Radiating clefts sometimes present.
5. *Polarization Crosses.* Brilliant.
6. *Selenite Plate.* Mediocre play of colors.

C. . . . . PEANUT.

1. *Size.* Grains from 5—15μ in diameter. (Never larger.)

2. *Form.* Spherical.
   a. Segmented spherical forms rare.
   b. Not found in compact aggregates.
3. *Laminae.* Not visible.
4. *Hilum.* Central, distinct.
5. *Polarization Crosses.* Faint.
6. *Selenite Plate.* No play of colors.

III. CIRCULAR, DISK-SHAPED GRAINS.

A. . . . . RYE.

1. *Size.* Grains occur in two sizes: 30—60μ in diameter and 8—14μ in diameter.
2. *Form.* Large grains circular.
   a. Occur singly.

   Small grains sphaero-polygonal.
   a. Seldom in aggregates.
   b. More numerous than in other starches of this class.
3. *Laminae.* Very distinct.
4. *Hilum.* Central, very distinct.
   a. Radiating clefts often present.
5. *Polarization Crosses.* Very distinct.
6. *Selenite Plate.* Play of colors.

B. . . . . WHEAT.

1. *Size.* Grains occur in two sizes; 25—50μ in diameter, and less than 9μ in diameter.
2. *Form.* Large circular flattened grains.
   a. Found singly.

   Small sphaero-polygonal grains.
   a. Singly or in loose aggregates.
3. *Laminae.* Indistinct.
4. *Hilum.* Central.
   a. Not usually cleft to any great extent.
5. *Polarization Crosses.* Indistinct, (diametrically opposite.)
6. *Selenite Plate.* No play of colors.

C. . . . . BARLEY.

1. *Size.* Two sizes of grains occur; large ones 20—30μ in diameter, small ones less than 7μ in diameter.
2. *Form.* Large grains irregularly circular.
   Small grains circular.
   a. Not in aggregates.
3. *Laminae.* Indistinct or lacking.
   a. Sometimes cleft.
4. *Hilum.* Indistinct or lacking.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Faint play of colors.

IV. ELLIPSOIDAL STARCH GRAINS.

A. . . . . BEAN (Common)

1. *Size.* Grains usually 15—60μ in length, (rarely 60μ.)
2. *Form.* Ellipsoidal or kidney shaped in case of larger grains.
3. *Laminae.* Usually distinct.
4. *Hilum.* Elongated.
   a. Branching cleft conspicuous.
5. *Polarization Crosses.* Brilliant distinct crosses.
6. *Selenite Plate.* Fine play of colors.

B. . . . . PEA.

1. *Size.* Grains usually less than 40μ in diameter.
2. *Form.* Ellipsoidal or roundly ellipsoidal.
   a. Rounded protuberances often present.
3. *Laminae.* Distinct.
4. *Hilum.* Elongated.
   a. Seldom distinctly cleft.
5. *Polarization Crosses.* Brilliant crosses.
6. *Selenite Plate.* Play of colors.

C. . . . . LENTIL.

1. *Size.* Grains usually less than 30μ in diameter. Few 40μ.
2. *Form.* Ellipsoidal.
   a. Very few grains have protuberances.

3. *Laminae.* Indistinct or lacking.
4. *Hilum.* Distinct.
    a. Elongated.
5. *Polarization Crosses.* Brilliant and distinct crosses.
6. *Selenite Plate.* Fine play of colors.

D. . . . . ACORN.

1. *Size.* Grains usually 15—20μ in diameter.
    a. Few varieties have grains up to 50μ in diameter.
2. *Form.* Ellipsoidal.
    a. More irregular than others of this class.
    b. Sometimes in aggregates of few grains.
3. *Laminae.* Invisible.
4. *Hilum.* Elongated, very distinct.
5. *Polarization Crosses.* Very indistinct or not visible.
6. *Selenite Plate.* No play of colors.

V. IRREGULAR GRAINS, (OVOID, PEAR-SHAPED, ROD-SHAPED, ETC.)

A. . . . . CURCUMA.

1. *Size.* Dependent on the variety. Grains usually 60—120μ long.
2. *Form.* Very much elongated Rod-like forms often present.
    a. Blunt point at hilum end.
3. *Laminae.* Distinct
4. *Hilum.* Small, distinct, in pointed end of grain.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Beautiful play of colors.

B. . . . . POTATO.

1. *Size.* Large grains from 65—100μ long. Seldom larger. Very few small grains.
2. *Form.* Oyster shell shaped. Sometimes broadly spindle shaped.
    a. Aggregates very rare.
3. *Laminae.* Very distinct.

4. *Hilum.* Distinct, in small end. Excentricity usually 1-3—1-6.
5. *Polarization Crosses.* Very distinct, striking.
6. *Selenite Plate.* Fine play of colors.

C. . . . . CANNA.

1. *Size.* Grains usually 50μ—100 long, occasionally larger.
2. *Form.* Flattened,—ellipsoidal. Obtusely angled at one end.
   a. No aggregates.
3. *Laminae.* Distinct, striking.
4. *Hilum.* Distinct, circular.
   a. Within obtuse angle.
   b. Excentricity 1-5—1-7.
5. *Polarization Crosses.* Remarkable, distinct.
6. *Selenite Plate.* Beautiful play of colors.

D. . . . . TUMERIC.

1. *Size.* Grains usually 40—80μ long. Seldom larger.
2. *Form.* Clam shaped, ovoid.
   a. Often in loose aggregates.
   b. Starch lumps yellow.
      1. Become crimson with H_2SO^4.
3. *Laminae.* Very distinct.
4. *Hilum.* Visible.
5. *Polarization Crosses.* No appreciable crosses.
6. *Selenite Plate.* No play of colors.

E. . . . . SAGO.

1. *Size.* Grains occur in two sizes; the larger 30—65μ long, the smaller 20μ and less in length.
2. *Form.* Very irregular.
   a. Ovoid, segmented-ellipsoidal.
   b. Aggregates of one large and two small grains often present.
      1. Contact surfaces (facets) not adjacent.
3. *Laminae.* Distinct.

4. *Hilum.* Distinct. Excentricity 1-3—1-5.
   a. Often crossed by clefts.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Fine play of colors.

F. . . . . MARANTA.

1. *Size.* 30—50μ long, (seldom larger.)
2. *Form.* Similar to potato, pear-shaped; also broad, spindle-shaped grains always present.
3. *Laminae.* Usually distinct.
4. *Hilum.* Distinct, in broad end of the grain.
   a. Usually cleft by curved, wing-like fissures.
5. *Polarization Crosses.* Distinct, striking.
6. *Selenite Plate.* Beautiful play of colors.

G. . . . . YAM.

1. *Size.* Grains range in size from 30—60μ in length. Seldom the latter.
2. *Form.* Irregular, ovate, reniform.
   a. Often segmented at broad end.
   b. End not pointed.
3. *Laminae.* Distinct evident.
4. *Hilum.* Distinct, circular in narrow end of grain. Excentricity 1-5—1-7.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Play of colors.

H. . . . . BANANA.

1. *Size.* Grains usually 20—40μ long. Occasionally larger grains are found.
2. *Form.* Cigar-shaped, rod-shaped, irregular-ellipsoidal.
   a. Occasionally aggregates of two grains, end to end, form sickle shaped bodies.
3. *Laminae.* Very distinct.
4. *Hilum.* Distinct, usually in broad end of grain.
   a. Rarely found in narrow end.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Play of colors evident.

I. . . . . CHESTNUT.

1. *Size.* Grains occur in two sizes, the larger being 15—30μ long; the smaller, 1—3μ long.
   a. No intermediate sizes found usually.
2. *Form.* Very irregular, pear-shaped, ellipsoidal, kidney-shaped, club-shaped, often pointed.
   a. Aggregates of 2—3 grains occasionally present.
3. *Laminae.* Indistinct or lacking.
4. *Hilum.* Round or elongated, often cleft.
5. *Polarization Crosses.* Distinct.
6. *Selenite Plate.* Dull play of colors evident.

J. . . . . CLOVE FRUIT.

1. *Size.* Grains usually from 10—40μ in diameter.
2. *Form.* Pear-shaped or segmented forms often occur.
   a. No aggregates.
3. *Laminae.* Distinct and delicate.
4. *Hilum.* Distinct, small.
   a. Always in broad end.
   b. Sometimes cleft.

INDEX

BULLETIN No. 142. OCTOBER, 1912.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION.

INSPECTION OF

Commercial Feed Stuffs

BY

P. H. SMITH, G. R. PIERCE and R. W. RUPRECHT.

This bulletin contains the text of the new feeding stuffs law, an article on low grade by-products, and the analyses of commercial feeding stuffs found in the Massachusetts markets during the year (September, 1911—September, 1912), together with such comments as are called for by the results of the inspection. In addition will be found a tabulated list of the wholesale cost of feeding stuffs for the year.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,

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Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

*On leave.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. LINDSEY, *Chemist.*

INSPECTION OF COMMERCIAL FEED STUFFS

By P. H. SMITH, *Chemist in Charge,*
Assisted by
G. R. PIERCE and R. W. RUPRECHT.

INTRODUCTION.

During the year (September, 1911 to September, 1912,) 902 samples of commercial feeding stuffs have been collected by James T. Howard, official inspector. These samples have been examined and the analytical results together with additional information are given in this bulletin.

The year has been uneventful in that the law has been well complied with, and few new feeding stuffs have been found. Prices have ruled high and our inspector reports that the stock on hand has been, during parts of the year, very low. This was due to the difficulty of getting shipments promptly and to the fact that, owing to the uncertainty of the market, dealers did not care to stock heavily.

The most important event of the year was the enactment of a new feeding stuffs law which took effect September 1, 1912. The text of the law follows:

AN ACT TO REGULATE THE SALE AND ANALYSIS OF FOOD STUFF USED FOR FEEDING LIVE STOCK AND POULTRY.

(Acts and Resolves for 1912, Chapter 527.)

Be it enacted, etc., as follows:

Definitions of Terms

SECTION 1. In this act, unless the context otherwise requires:—The term "commercial feeding stuff" shall include all feeding stuff used for feeding live stock and poultry and containing not more than

sixty per cent of water, except whole seeds or grains, and the unmixed meals made directly from the entire grains of corn, wheat, rye, barley, oats, buckwheat, flaxseed, kafir, and milo, whole hays, whole straws, unground cotton seed hulls and unground corn stover when unmixed with other materials.

The term "cattle feed" shall include all materials used for feeding live stock and poultry.

"Brand" shall mean any commercial feeding stuff or cattle feed distinctive by reason of name, trade-mark or guaranteed analysis or by any method of marking.

"Crude protein" shall mean the percentage of nitrogen multiplied by the factor six and twenty-five one hundredths.

"Copy" shall mean certified copy.

"Feeding stuff" shall mean commercial feeding stuff.

"Importer" shall mean a person who procures for sale or distribution in this commonwealth commercial feeding stuff or cattle feed from other states or countries.

"Label" shall mean printed label.

"Package" shall include sacks and bags, tins, boxes, jars, and similar receptacles.

"Person" shall include a corporation or partnership of two or more persons having a joint or common interest.

"Tag" shall mean printed tag.

Statements to Be Printed on Label Accompanying the Feeding Stuff

SECTION 2. Every package, lot or parcel of commercial feeding stuff sold or offered or exposed or kept for sale or distributed within this Commonwealth shall have affixed thereto in a conspicuous place, as hereinafter set forth, a tag or label containing a legible and plainly printed statement in the English language clearly and truly certifying:

(*a*) the weight of the contents of the package, lot or parcel;
(*b*) the name, brand or trade-mark;
(*c*) the name and principal address of the manufacturer or person responsible for placing the commodity on the market;
(*d*) the minimum *per cent* of crude protein;
(*e*) the minimum *per cent* of crude fat;
(*f*) the maximum *per cent* of crude fibre,
(*g*) the specific name of each ingredient used in its manufacture.

Concerning Attachment of Label

SECTION 3. When any feeding stuff is sold or offered, exposed or kept for sale or distributed in packages, the tag or label shall be affixed in a conspicuous place on the outside thereof. When any feeding stuff is offered, exposed or kept for sale in bulk, the tag or label shall be affixed in a conspicuous place on the bin or other enclosure in which the feeding stuff is contained, but need not state the number of pounds thereof. And when any feeding stuff is sold or distributed in bulk the label shall be affixed in a conspicuous place on the car or other vehicle in which the feeding stuff is shipped or delivered or distributed and shall state the number of pounds thereof. When any feeding stuff is sold in packages furnished by the purchaser the seller shall furnish the tags or labels therefor. The provisions of the printed tag or label required by this act relating to the constituents contained in any commercial feeding stuff shall be known and recognized as the guaranteed analysis of such feeding stuff.

Registration of Guarantee Required

SECTION 4. Before any manufacturer, importer or other person shall sell, or offer, expose, or keep for sale, or distribute in this commonwealth any commercial feeding stuff, he shall file with the director of the Massachusetts agricultural experiment station, or his authorized deputy, for registration, a copy certified by him to be a true copy of the tag or label required by this act, excepting the item as to the number of pounds, for every brand of feeding stuff to be sold or offered, exposed or kept for sale or to be distributed in this commonwealth. But no agent or other person shall be obliged to file a copy of the tag or label of any brand of feeding stuff, a copy of which has been filed by the manufacturer or importer of such brand and for which a certificate of registration has been issued. No feeding stuff or brand of feeding stuff shall be sold or offered, exposed or kept for sale or distributed in this commonwealth until the tag or label therefor has been registered by the director of the Massachusetts agricultural experiment station, or his authorized deputy, and a certificate of such registration has been issued by him.

Time of Registration

SECTION 5. A certified copy of the tag or label required by this act shall be filed with the director of the Massachusetts agricultural experiment station, or his authorized deputy, for registration prior to the first day of September in each year for every brand of commercial feeding stuff to be sold or offered, exposed or kept for sale or to be distributed in this commonwealth during the year beginning with said first day of September. The said director or his authorized deputy may thereafter permit a manufacturer, importer or other person to file a copy of the tag or label of a brand of feeding stuff, and may register the same for said year in accordance with the rules and regulations which may be prescribed by the said director.

Director to Issue Certificates Authorizing Sale After Feeding Stuffs Are Registered

SECTION 6. When the certified copy of the tag or label of any brand of commercial feeding stuff has been filed as provided by this act, the director of the Massachusetts agricultural experiment station, or his authorized deputy, shall register such tag or label if he finds the same to be in accordance with the requirements of this act, and shall issue, or cause to be issued, a certificate of such registration, and the said certificate shall be deemed to authorize the sale in this commonwealth, in compliance with this act, of the brand of feeding stuff for which the certificate is issued, up to and including the thirty-first day of August of the year for which it is issued.

Director May Refuse to Register Feeding Stuffs if Statements Are Misleading

SECTION 7. The director of the Massachusetts agricultural experiment station or his authorized deputy may refuse to register any commercial feeding stuff under a name, brand, or trade-mark which, in his opinion, would be misleading or deceptive, or which would tend to mislead or deceive as to the materials of which the feeding stuff is composed. The director or his said deputy may refuse to register more than

one feeding stuff under the same name or brand, or to register any feeding stuff under a name or brand to the use of which the applicant for registration is not lawfully entitled. Should any feeding stuff be registered in this commonwealth and it be discovered afterward that any provision of this act was violated in obtaining such registration or that such registration is in any respect in violation of any provision of this act, the director of the Massachusetts agricultural experiment station, and his authorized deputy, shall have power to cancel such registration and the certificate issued therefor. No manufacturer, importer, or other person shall sell or offer or expose or keep for sale or distribute in this commonwealth any commercial feeding stuff, registration whereof has been cancelled by the director or his authorized deputy.

Director or Deputy Authorized to Collect and Analyze Feeding Stuffs

SECTION 8. Every commercial feeding stuff and cattle feed, or brand thereof, sold or offered, exposed or kept for sale or distributed in this commonwealth shall be subject to analysis by the director of the Massachusetts agricultural experiment station, or by his designated deputy or deputies, and the said director is hereby authorized and it is made his duty to make or cause to be made in each year one or more analyses of every brand of feeding stuff sold or offered, exposed or kept for sale or distributed in this commonwealth, and he is hereby given free access in person and by deputy to all places of business, mills, buildings, carriages, cars, vessels and other receptacles of whatsoever kind used in the manufacture, sale, storage or delivery of any feeding stuff or cattle feed in this commonwealth, or in the importation or transportation of any feeding stuff or cattle feed for sale or distribution in this commonwealth. The director and his deputies are further authorized to open any receptacle containing or supposed to contain any feeding stuff or cattle feed for sale or distribution as aforesaid, and to take samples for analysis, as provided by this act. The methods of analyses of all feeding stuffs and cattle feeds shall be those in force at the time by the Association of Official Agricultural Chemists of North America.

Results of Analyses to Be Published

SECTION 9. The said director shall have the right to publish or cause to be published in reports, bulletins, special circulars, or otherwise the results obtained by said analyses, and said reports, bulletins, circulars, or other publications, shall contain such additional information in relation to the character, composition, value and use of the feeding stuffs or cattle feed analyzed as the director may, in his discretion, see fit to include. The said director, in his discretion may at any time make or cause to be made for consumers a free analysis of any brand of feeding stuff or cattle feed sold or offered or exposed or kept for sale or distributed in this commonwealth; but all samples for such free analysis shall be taken and submitted in accordance with the rules and regulations which may be prescribed by the director. The results of any analysis of a commercial feeding stuff made in accordance with the provisions of this act, except a free analysis as aforesaid, shall be sent by the director, at least fifteen days before any publication thereof, to the person named on the tag or label of the feeding stuff analyzed.

Sampling of Feeding Stuffs

SECTION 10. All samples for analysis of any commercial feeding stuff or cattle feed shall be taken, whenever the circumstances conveniently permit, in the presence of at least one witness, and no action shall be maintained for a violation of the provisions of this act, based upon an analysis of a sample taken from less than five separate original packages, unless there be less than five separate original packages in the lot, in which case parts of the official sample shall be taken from each original package. If the feeding stuff or cattle feed is in bulk, parts shall be taken from not less than five different places in the lot: *provided*, that this shall not exclude sampling from bulk when the feeding stuff or cattle feed is not exposed sufficiently to take parts from five different places, in which case parts shall be taken from as many places as practicable. All samples thus taken shall be placed in suitable vessels, marked and sealed. A part of each sample shall be held by the said director or his deputy at the disposal of the person named on

the tag or label of the feeding stuff sampled for fifteen days after the results of the analysis have been reported as provided in Section Nine.

SECTION 11. No commercial feeding stuff or cattle feed or brand thereof that has been mixed or adulterated with any substance or substances injurious to the health of live stock or poultry shall be sold or offered or exposed or kept for sale or distributed in this commonwealth.

Violators of This Act Punishable by Fine

SECTION 12. Any manufacturer, importer, or other person who shall sell or offer, expose or keep for sale, or distribute in this commonwealth, any commercial feeding stuff without the tag or label required by this act, or with a tag or label that has not been registered, or with a tag or label the registration of which has been cancelled by the director of the Massachusetts agricultural experiment station or his authorized deputy or who shall file with the said director or his authorized deputy for registration a false copy of the tag or label of any feeding stuff or brand of feeding stuff or who shall impede, obstruct or hinder the director or any of his deputies in the discharge of the authority or duty conferred or imposed by any provision of this act, or who shall sell or offer, expose or keep for sale or distribute in this commonwealth any feeding stuff which contains a smaller per cent of crude protein or crude fat, or a larger per cent of crude fibre than is certified in the tag or label of such feeding stuff to be contained therein, or who shall fail properly to state the specific name of every ingredient used in its manufacture, or who shall sell, or offer, expose or keep for sale or distribute in this commonwealth any feeding stuff or cattle feed or brand thereof which has been mixed or adulterated with any substance or substances injurious to the health of live stock or poultry shall be deemed guilty of a violation of this act and upon conviction any such manufacturer, importer or other person shall be fined not more than one hundred dollars for the first violation, and not less than one hundred dollars for each subsequent violation.

Director Required to Enforce Provisions of This Act

SECTION 13. It shall be the duty of the director of the Massachusetts agricultural experiment station to see that the provisions of this act are complied with, and he may prescribe and enforce such rules and regulations relative to the sale of commercial feeding stuff or cattle feed as he deems necessary to carry into effect the full intent and meaning of this act. He may in his discretion prosecute or cause to be prosecuted any person violating any provision of this act, and no complaint shall be made or prosecuted for any such violation except with the authorization or approval of the said director.

SECTION 14. To defray the cost of collecting samples, making analyses, and of otherwise carrying out the provisions of this act, a sum not exceeding six thousand dollars shall be allowed annually from the treasury of the commonwealth, payable in quarterly payments into the treasury of said station. All moneys received and disbursed under this act shall be kept in a separate account and shall be audited and reported as are other moneys placed in charge of the trustees of the Massachusetts Agricultural College. In case at any time there should be a surplus, the surplus shall be used in the Massachusetts agricultural experiment station, under the authority of its director, for experiments and research relative to the feeding of farm animals.

SECTION 15. Chapter one hundred and twenty-two of the acts of the year nineteen hundred and three, chapter three hundred and thirty-two of the acts of the year nineteen hundred and four, and all acts and parts of acts inconsistent herewith are hereby repealed.

SECTION 16. This act shall take effect on the first day of September in the year nineteen hundred and twelve. (*Approved April* 25, 1912.)

The new law differs from the law which it replaces in the following essentials:

1. *Guarantee.* In addition to a guarantee of the minimum percentage of protein and fat, as formerly required, a guarantee of the maximum fiber content must also be given.

In case of mixed or compounded feeds, a statement of the ingredients contained therein must be included in the guarantee.

2. *Registration.* Registration of all feeding stuffs is now necessary although no fee is required. Upon application, the proper forms for registration will be forwarded.

3. *Appropriation.* In place of the $3,000 formerly allowed for carrying out the provisions of the act, $6,000 is now appropriated.

4. *Phraseology.* The law has been put in such form as to be more explicit in the statement of its requirements. Before being submitted for enactment, the text was carefully reviewed not only by officials of this station, but by those of other experiment stations and also by a committee of feed dealers from the Boston Chamber of Commerce. It was finally submitted to a competent attorney for corrections and approval.

5. *Wheat Feeds* are now included; in the former law these were omitted.

The law practically conforms to the uniform law advocated by the Association of Feed Control Officials and which has received the endorsement of the American Feed Manufacturers' Association.

It is felt that the new law will more effectually safeguard the interests of the Massachusetts farmer than the former act and that the compliance with its requirements will not be any more difficult for the honest manufacturer or jobber. The earnest co-operation of all interested in the manufacture, sale or consumption of commercial feeding stuffs is most earnestly desired.

The acknowledgment is made of the co-operation of members of the Boston Chamber of Commerce, of the Secretary of the State Board of Agriculture, of a representative of the State Grange, and of others in securing the passage of the law.

CHEMICAL ANALYSIS OF FEED STUFFS.

1911-1912 [*Fall and Winter.*]

I. Protein Feeds.

COTTONSEED MEAL

Definitions. *COTTONSEED MEAL is the ground residue obtained in the extraction of oil from the cottonseed kernel.
CHOICE cottonseed meal contains at least 41 per cent protein.
PRIME cottonseed meal contains from 38.5 to 41 per cent protein.
GOOD cottonseed meal contains from 36 to 38.5 per cent protein.
COTTONSEED FEED is a mixture of cottonseed meal and cottonseed hulls containing less than 36 per cent protein.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
Choice.		%	%	%	%	%	%
American Cotton Oil Co., New York.							
Rollstone Grain Co.	Fitchburg	42.12	41.00	9.08	9.00	8.79	10.50
J. F. Ray	Franklin	42.08	41.00	7.62	8.00	10.05	10.50
D. W. Foskett	Palmer	41.20	41.00	7.97	9.00	9.69	10.50
Taunton Grain Co.	Taunton	40.60	41.00	9.63	9.00	10.03	10.50
C. E. Terry	W. Springfield	43.30	41.00	7.33	9.00	7.40	10.50
F. W. Brode & Co., Memphis, Tenn.							
Dove, J. Cushing & Co.	Hudson	41.64	38.62	7.53	6.00	9.60	10.00
Owl, W. E. Bryant & Co.	Brockton	41.73	41.00	6.92	6.00	8.22	10.00
Owl, W. H. Garland	Gloucester	41.12	41.00	8.18	6.00	7.00	10.00
Owl, M. H. Rolfe Est.	Newburyport	41.47	41.00	7.54	6.00	7.42	10.00
Owl, Berkshire Coal & Grain Co.	N. Adams	43.61	41.00	10.78	6.00	7.60	10.00
Owl, H. H. Capen	Spencer	41.24	41.00	6.97	6.00	8.14	10.00
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
Prime, J. Burkhardt	Beverly	41.99	38.50	7.51	6.50	8.80	10.00
Prime, G. H. Reed	W. Acton	41.84	38.50	8.42	6.50	6.85	10.00
T. H. Bunch Commission Co., Little Rock, Ark.							
Old Gold, F. H. Fales & Co.	Norwood	41.77	41.00	8.62	9.00	7.28	9.00
S. P. Davis, Little Rock, Ark.							
Good Luck, C. P. McClanathan	Barre Plains	42.25	41.00	6.91	7.00	7.39	10.50
Good Luck, E. J. Adams	Gt. Barrington	43.39	41.00	10.48	7.00	4.70	10.50
Good Luck, W. R. Ross & Co.	Holyoke	40.89	41.00	8.07	7.00	8.75	10.50
Good Luck, Beaver Coal & Grain Co.	Norwood	40.63	41.00	7.30	7.00	9.12	10.50
J. B. Garland & Son, Worcester, Mass.							
Golden Eagle, J. B. Garland & Son	Worcester	44.39	41.00	6.85	9.00	6.48	—
Humphreys, Godwin & Co., Memphis, Tenn.							
Dixie, J. H. Nye,	Brockton	42.64	38.62	8.12	6.00	7.29	12.00
Dixie, D. Seffens	Conway	42.08	38.62	8.03	6.00	7.05	12.00
Dixie, J. N. Waite	Easthampton	41.77	38.62	7.18	6.00	4.90	12.00
Dixie, W. J. Meek	Fall River	42.12	38.62	7.51	6.00	8.18	12.00
Dixie, A. H. Wood & Co.	Framingham	40.72	38.62	7.92	6.00	7.02	12.00
Dixie, A. D. Potter	Orange	42.47	38.62	8.45	6.00	6.78	12.00
Dixie, Morse Bros.	Southbridge	42.12	41.00	8.03	6.00	7.68	10.00
Dixie, H. W. Hill Est.	Williamsburg	40.68	38.62	8.03	6.00	9.85	12.00
Keeton-Krueger Co., Atlanta, Georgia.							
Peacock, J. Cushing & Co.	Hudson	42.03	41.00	7.50	6.00	6.98	10.00
Kemper Mill & Elevator Co., Kansas City, Mo.							
J. Franks	New Bedford	41.42	41.00	7.37	7.50	7.59	10.00

*Definitions used in connection with these tables merely indicate our basis of classification. In so far as possible they are based on trade usage, and are subject to future change and revision.

COTTONSEED MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Memphis Cottonseed Products Co., Memphis, Tenn.							
Selden, ... F. F. Woodward & Co. ...	Fitchburg	42.73	41.00	7.86	6.00	6.75	10.00
Selden, ... C. A. Pierce	Hinsdale	41.16	41.00	9.15	6.00	6.70	10.00
Selden .... Milford Grain Co.	Milford	40.50	41.00	6.33	6.00	8.78	10.00
Selden, ... Highland Mills...........	Newton High's	46.23	41.00	6.23	6.00	6.67	10.00
Selden, ... C. O. Parmenter & Co. ...	S. Sudbury....	42.43	41.00	7.62	6.00	6.83	10.00
F. E. Morse & Co., Little Rock, Ark.							
Golden, ... Ropes Bros.	Salem	43.52	41.00	6.01	9.00	8.65	—
W. C. Northern, Little Rock, Ark.							
Bee, ... G. Methe & Sons.........	Springfield ...	45.31	41.00	8.42	7.00	7.55	10.50
W. Newton Smith, Baltimore, Maryland.							
Dirigo, ... B. W. Brown	Concord	41.73	41.00	7.43	7.00	9.28	10.50
J. E. Soper Co., Boston, Mass.							
Pioneer, ... M. C. Richmond	Adams	41.73	41.00	6.48	7.00	9.58	10.00
Pioneer, ... McKenzie & Winslow	Fall River	43.13	41.00	8.87	7.00	6.33	10.00
Pioneer, ... D. B. Hodgkins Sons	Manchester ..	40.63	41.00	7.08	7.00	8.95	10.00
Pioneer, ... Thorne Bros.	Millis	41.59	41.00	7.19	7.00	8.89	10.00
McKenzie & Winslow	Fall River	40.59	41.00	7.46	8.00	8.33	—
Prime.							
American Cotton Oil Co., New York.							
*Choice, ... W. Lord	Athol	39.76	41.00	6.97	9.00	10.35	10.50
F. W. Brode & Co., Memphis, Tenn.							
Dove, ... E. A. Cowee	Jefferson	39.93	38.62	7.50	6.00	5.90	10.00
Owl, ... J. Paull & Co.	Taunton	40.19	41.00	7.16	6.00	9.40	10.00
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
N. Hatfield Grain Co.	N. Hatfield ...	39.31	39.00	8.54	6.50	7.73	10.00
Cutler Co...............	W. Brookfield .	39.10	38.50	7.00	6.50	9.05	10.00
T. H. Bunch, Little Rock, Ark.							
Old Gold, ... C. Bond	Charlton	39.98	41.00	6.73	9.00	8.99	—
T. H. Bunch Commission Co., Little Rock, Ark.							
Acme, ... J. W. Raymond	Concord	39.45	38.60	7.95	7.00	9.50	12.00
J. B. Garland & Son, Worcester, Mass.							
*Golden Eagle .... Dodge Mill Co.	Saundersville .	38.18	41.00	7.52	9.00	8.18	—
Humphreys, Godwin & Co., Memphis, Tenn.							
Dixie, ... W. L. Palmer	Medway	38.79	38.62	11.50	6.00	7.05	12.00
Dixie, ... Thorne Bros.	Millis	38.14	38.62	6.63	6.00	10.52	12.00
Dixie, ... H. Bruckman	S. Lawrence ..	40.15	38.62	6.81	6.00	9.23	12.00
Dixie, ... Warner Bros.	Sunderland ...	38.63	38.62	8.23	6.00	9.13	12.00
Dixie, ... A. Milot & Co.	Taunton	39.41	38.62	7.15	6.00	10.22	12.00
Keeton-Krueger Co., Atlanta, Georgia.							
Peacock, ... J. Shea	Lawrence	38.70	41.00	7.52	6.00	10.26	10.00
Kemper Mill & Elevator Co., Kansas City, Mo.							
*Choice, ... J. F. Ray	Franklin	38.75	41.00	7.75	7.50	9.64	10.00
*Choice, ... Smith Feed Co.	Westfield	40.11	41.00	7.83	7.50	9.20	10.00

*Misbranded Choice.

COTTONSEED MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
W. Newton Smith, Baltimore, Maryland.							
Dirigo, ... R. W. Davies	Greenfield	39.63	38.62	8.53	7.00	8.53	10.50
Dirigo, ... S. L. Davenport & Sons, .	North Grafton	39.41	38.62	8.38	7.00	8.52	10.50
Dirigo, ... W. N. Potter Grain Co. ...	Princeton	39.23	38.62	6.93	7.00	9.43	10.50
J. E. Soper Co., Boston, Mass.							
Pioneer, ... Bowen & Fuller	Leominster....	39.31	41.00	6.82	7.00	10.41	10.00
Good.							
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
**Prime, ... Howe Bros..............	Gardner	36.39	38.50	6.42	6.50	12.48	10.00
Humphreys, Godwin & Co., Memphis, Tenn.							
Dixie, ... Taunton Grain Co.	Taunton	37.65	38.62	6.77	6.00	12.15	12.00
Cottonseed Feed.							
Humphreys, Godwin Co., Memphis, Tenn.							
Creamo, ... Hoosac Val. Coal & Gr. Co.	Adams	20.66	22.00	4.18	5.00	21.20	22.00
Creamo, ... W. J. Meek	Fall River	26.79	22.00	5.87	5.00	16.84	22.00
Creamo, ... Plummer & Jennings Gr. Co.	New Bedford .	24.69	22.00	5.23	5.00	18.65	22.00
Creamo, ... I. J. Rowell	Pepperell	23.87	22.00	5.12	5.00	19.10	22.00
Creamo, ... J. B. Bridges & Co........	S. Deerfield ...	24.08	22.00	4.98	5.00	18.85	22.00
Creamo, ... Warner Bros.	Sunderland ...	22.59	22.00	4.77	5.00	19.12	22.00
77 Feed Meal...... W. J. Meek	Fall River	19.94	22.00	3.78	4.50	20.91	28.00

**Misbranded Prime.

LINSEED MEAL.

Definition. Linseed meal is the ground residue obtained in the extraction of oil from flaxseed.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
1. New Process.							
American Linseed Co., New York.							
Cleveland Flaxmeal, C. B. Sawin & Son	Southboro	36.66	36.00	1.90	1.00	8.63	7.50
Cleveland Flaxmeal, C. B. Sawin & Son	Southboro	37.39	36.00	2.13	1.00	8.38	—
E. E. Cole Co.	Billerica	37.39	36.00	2.73	1.00	7.69	—
A. M. Reed	N. Westport ..	37.30	36.00	2.40	1.00	8.45	7.50
M. G. Williams	Raynham	36.74	36.00	2.33	1.00	8.30	7.50
2. Old Process.							
American Linseed Co., New York.							
A. Dodge & Sons	Beverly.......	38.38	32.00	6.33	5.00	6.46	5.50
C. H. Laflin	Brookfield	38.30	32.00	5.66	5.00	7.18	7.00
E. J. Adams	Gt. Barrington	35.69	34.00	5.92	5.00	7.68	8.00
S. L. Davenport & Son	N. Grafton....	39.10	32.00	5.10	5.00	6.70	7.00
H. Bruckman	S. Lawrence ..	37.91	34.00	5.80	3.00	7.63	5.00
Archer-Daniels Linseed Co., Minneapolis, Minn.							
J. B. Cover & Co.	Lowell........	36.43	32.00	6.33	6.00	7.63	10.00
W. L. Palmer	Medway	37.21	32.00	6.77	6.00	7.00	10.00
Knight Grain Co.	Newburyport..	36.30	32.00	5.85	6.00	7.73	12.00
Kelloggs & Miller, Amsterdam, N. Y.							
Potter Bros. & Co.	N. Adams	36.21	33.00	8.05	5.00	7.31	7.50
W. N. Potter Grain Co. .	Princeton	38.92	33.00	6.70	5.00	6.78	7.50
W. N. Potter Grain Co. ..	Princeton	38.53	33.00	7.16	5.00	7.10	7.50

LINSEED MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Guy G. Major Co., Toledo, Ohio.							
E. H. Cole	Housatonic	33.45	30.00	6.22	5.00	8.68	10.00
T. E. Borden	N. Westport	34.20	30.00	6.75	5.00	8.48	10.00
Glen Mills Cereal Co.	Rowley	36.05	30.00	8.18	5.00	7.13	10.00
H. C. Puffer Co.	Springfield	33.19	30.00	6.90	5.00	8.33	10.00
Metzger Seed & Oil Co., Toledo, Ohio.							
J. F. Ray	Franklin	33.59	30.00	9.68	5.00	7.87	10.00
C. T. Wyman	Hubbardston	28.02	30.00	7.01	5.00	5.28	10.00
A. Carr	Northboro	29.47	30.00	6.47	5.00	8.99	10.00

GLUTEN MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Corn Products Refining Co., New York.							
Diamond, McKenzie & Winslow	Fall River	44.26	40.00	2.40	1.50	2.73	4.00
Diamond, H. L. Patrick	Hopedale	42.08	40.00	0.82	1.50	3.30	1.50
Diamond, J. Shea	Lawrence	43.48	40.00	1.40	1.50	1.30	1.50
Diamond, I. J. Rowell	Pepperell	41.33	40.00	1.52	1.50	3.15	4.00
Diamond, W. N. Potter Grain Co.	Princeton	44.61	40.00	1.40	1.50	1.35	4.00
Diamond, Morse Bros.	Southbridge	46.40	40.00	1.53	1.50	1.15	1.50
Diamond, J. B. Garland & Son	Worcester	42.80	40.00	0.98	1.50	1.18	1.50

GLUTEN FEED.

Definition. Gluten feed is a product obtained in the manufacture of starch and glucose from corn, and consists largely of the flinty portion of the kernel and corn bran.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
American Maize Products Co., New York.							
Cream of Corn, Bond Grain Co.	Charlton	26.75	23.00	1.83	2.50	5.33	8.50
Cream of Corn, G. M. Foster	Lowell	25.92	23.00	3.28	2.50	6.64	8.50
Cream of Corn, Blood Bros.	Medfield	25.13	23.00	2.52	2.50	6.95	8.50
Cream of Corn, H. Houghton	Millbury	26.27	23.00	2.40	2.50	6.75	8.50
Clinton Sugar Refining Co., Clinton, Iowa.							
Clinton, J. E. Merrick & Co.	Amherst	25.97	20.00	3.13	3.00	6.93	7.50
Clinton, J. E. Merrick & Co.	Amherst	25.62	20.00	3.82	3.00	6.83	7.50
Corn Products Refining Co., New York.							
Buffalo, A. T. Butler	Adams	26.44	24.00	2.53	2.50	7.30	8.50
Buffalo, C. H. Laflin	Brookfield	28.42	24.00	1.67	2.50	6.53	3.50
Buffalo, G. F. Greene Coal Co.	Campello	25.66	23.00	2.12	2.50	6.25	3.50
Buffalo, Lummus & Parker	Danversport	26.44	23.00	2.26	2.00	7.82	8.50
Buffalo, Bosworth & Son	Leominster	27.80	23.00	2.60	2.50	6.66	—
Buffalo, Conant & Co.	Littleton	28.11	23.00	3.05	2.50	6.20	8.50
Buffalo, W. L. Palmer	Medway	28.54	23.00	1.65	2.50	6.45	8.50
Buffalo, I. J. Rowell	Pepperell	23.81	23.00	2.60	2.50	5.62	8.50
Buffalo, M. G. Williams	Raynham	26.97	23.00	1.60	2.50	6.32	8.50
Buffalo, Taunton Grain Co.	Taunton	26.84	23.00	2.30	2.50	7.33	8.50
Buffalo, Prentiss, Brooks & Co.	Westfield	26.84	23.00	1.47	2.50	6.03	8.50
Buffalo, P. W. Eaton & Co.	Williamstown	27.23	23.00	2.23	2.50	6.43	3.00
Crescent, McKenzie & Winslow	Fall River	27.84	23.00	1.38	2.50	6.25	8.50
Crescent, M. H. Rolfe Est.	Newburyport	25.35	23.00	2.13	2.50	8.02	8.50
Globe, Scott Grain Co.	Amesbury	27.93	23.00	3.83	2.50	6.70	3.50
Curley Bros.	Wakefield	27.93	23.00	2.67	2.50	5.64	8.50
Douglas & Co., Cedar Rapids, Iowa.							
Cedar Rapids, Jacobson Bros.	N. Dartmouth	20.36	20.00	3.40	2.00	7.21	8.00
Cedar Rapids, J. Paull & Co.	Taunton	21.54	20.00	2.39	3.00	6.98	8.00

GLUTEN FEED (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Huron Milling Co., Harbor Beach, Mich.							
Jenks, ... J. F. Hunt	Lynn	23.05	23.00	4.37	7.50	7.12	—
Jenks, ... A. Altman...............	New Bedford .	25.13	22.00	3.49	3.00	7.63	8.00
Jenks, ... J. Franks	New Bedford .	24.83	22.00	2.95	3.00	7.30	8.00
J. E. Soper Co., Boston, Mass.							
Bay State, ... W. H. Garland...........	Gloucester ...	22.38	20.00	2.67	4.00	7.02	9.00
Bay State, ... W. H. Garland...........	Gloucester	19.13	22.00	2.13	4.00	5.51	8.00
Bay State, ... McKenzie & Winslow	Fall River	19.83	20.00	2.47	4.00	5.08	8.00

DISTILLERS' DRIED GRAINS.

Definition. Distillers' dried grains are the dried residue obtained from cereals in the manufacture of alcohol and distilled liquors.

Ajax Milling & Feed Co., Buffalo, N. Y.							
Ajax Flakes, ... C. S. Barber	Bernardston...	31.96	30.00	14.07	11.00	12.13	14.00
Ajax Flakes, ... Eastern Grain Co.	Bridgewater ..	29.73	30.00	10.98	11.00	10.22	14.00
Ajax Flakes ...... J. H. Nye	Brockton	30.29	30.00	11.87	11.00	12.10	14.00
Ajax Flakes, ... F. H. Whitaker	E. Longmeadow	30.34	30.00	10.52	11.00	7.18	14.00
Ajax Flakes, ... Morse Bros.	Southbridge ..	32.45	30.00	11.53	10.00	10.28	14.00
J. W. Biles Co., Cincinnati, Ohio.							
Dearborn, ... A. F. Sanctuary	Amherst	23.69	22.00	8.53	8.00	12.43	15.00
Dearborn, ... A. Carr	Northboro	24.52	22.00	9.56	8.00	11.65	15.00
Fourex, ... W. E. Bryant & Co.	Brockton	31.05	31.00	13.73	12.00	10.77	13.00
Fourex, ... F. H. Whitaker	E. Longmeadow	31.40	31.00	10.53	12.00	11.05	13.00
Fourex, ... McKenzie & Winslow	Fall River	32.00	31.00	12.00	12.00	12.40	13.00
Fourex, ... McKenzie & Winslow	Fall River	32.80	31.00	9.81	12.00	13.65	13.00
Fourex, ... W. N. Potters Sons & Co. .	Hadley	29.38	31.00	11.70	12.00	10.45	13.00
Fourex, ... Potter Bros. & Co.	N. Adams	30.56	31.00	13.48	12.00	12.33	13.00
Fourex, ... W. N. Potter Grain Co. ..	Princeton	29.24	31.00	11.07	12.00	10.09	13.00
Fourex, ... Cutler Grain Co.	S. Framingham	30.74	31.00	12.47	12.00	10.65	13.00
Fourex, ... Cutler Grain Co.	S. Framingham	30.83	31.00	11.81	12.00	12.02	13.00
Fourex, ... J. Cushing & Co.	Winchendon ..	32.70	31.00	14.82	12.00	10.70	13.00
Continental Cereal Co., Peoria, Ill.							
Continental, ... A. C. Boice	Conway	30.43	31.00	10.84	13.50	8.37	8.50
Continental, ... N. Hatfield Grain Co.	N. Hatfield ...	29.12	31.00	10.69	13.50	7.28	8.50
Continental, ... E. C. Frost	Shelburne Falls	30.03	33.00	11.33	14.00	7.95	—
Hottlelet Co., Milwaukee, Wis.							
Hector, ... N. Hatfield Grain Co.	N. Hatfield ...	29.20	30.00	8.23	10.00	10.23	14.00
Rye, ... Bedford Coal & Grain Co.	Bedford	13.45	16.00	6.13	6.00	16.85	16.00
Husted Milling Co., Buffalo, N. Y.							
H. L. Patrick	Hopedale	33.19	30.00	12.94	8.00	11.00	11.00
H. L. Patrick	Hopedale	32.62	30.00	11.92	8.00	11.62	11.00
Marlboro Grain Co., Marlboro.							
D, ... Marlboro Grain Co.	Marlboro	16.28	13.00	6.06	4.00	12.35	15.00
J. D. Page & Co., Syracuse, N. Y.							
Empire State, ... J. E. Merrick & Co.	Amherst	27.93	29.00	9.67	12.00	11.60	12.00

MALT SPROUTS.

Definition. Malt sprouts consist of the dried sprouts of the barley grain removed after the process of malting.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
American Malting Co., Buffalo, N. Y.							
A. E. Lawrence & Son	Ayer	24.39	23.00	2.17	.019	13.38	14.00
J. B. Bridges & Co.	S. Deerfield	28.89	25.00	0.77	.019	12.93	14.00
Atlantic Export Co., Chicago.							
C. L. Marsh	Webster	25.62	22.00	1.60	1.00	10.18	16.00
J. B. Garland & Son	Worcester	24.47	25.00	1.38	1.50	10.36	12.00
J. B. Garland & Son	Worcester	25.27	22.00	1.37	1.00	9.80	16.00
Francis Duhne, Jr., Milwaukee, Wis.							
J. W. Doon & Son	Natick	25.62	25.00	1.07	2.00	13.60	11.00
S. L. Davenport & Son	North Grafton	29.47	25.00	1.15	2.00	10.70	11.00
J. B. Garland & Son	Worcester	26.27	25.00	1.30	2.00	10.68	11.00
Hottelet Co., Milwaukee, Wis.							
Knight Grain Co.	Newburyport	23.60	26.50	1.68	2.50	11.35	—
Warner Bros.	Sunderland	25.83	26.50	1.15	2.50	13.13	—
Henry Rang & Co., Chicago, Ill.							
McKenzie & Winslow	Fall River	23.47	25.00	1.85	2.00	10.20	11.00
W. J. Meek	Fall River	24.22	25.00	1.02	2.00	10.38	11.00
E. A. Cowee	Jefferson	27.93	25.00	1.00	2.00	11.17	11.00
W. H. Cunningham & Son	Malden	23.64	25.00	1.30	2.00	11.99	11.00
C. O. Parmenter	S. Sudbury	31.40	25.00	1.32	2.00	10.60	11.00
M. G. Rankin & Co., Milwaukee, Wis.							
W. A. Haynes Co. Inc.	Maynard	27.49	23.00	1.81	1.50	10.73	17.00
D. W. Ranlet Co., Boston.							
Ropes Bros.	Salem	23.41	23.00	2.78	1.00	10.13	—

BREWERS' DRIED GRAINS.

Definition. Brewers' dried grains are the dried residue obtained from cereals in the manufacture of malted liquors.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber Found	Fiber Guar.
Providence Brewing Co., Providence, R. I.							
Blood Bros.	Medfield	29.16	22.00	6.87	5.00	11.88	—
W. L. Palmer	Medway	23.43	22.00	5.23	5.00	16.24	—
W. L. Palmer	Medway	26.97	22.00	5.51	5.00	13.44	—

ADULTERATED WHEAT FEEDS.

Definition. Adulterated wheat feeds are wheat products to which has been added material derived from some other source than wheat.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber Found	Fiber Guar.
Indiana Milling Co., Terre Haute, Ind.							
Sterling, A. E. Lawrence & Son	Ayer	9.85	9.80	2.82	2.75	15.23	14.00
Sterling, E. E. Cole	Billerica	8.41	9.80	2.20	2.75	19.13	14.00
Sterling, W. J. Meek	Fall River	11.25	9.80	3.68	2.75	12.93	14.00
Sterling, W. R. Ross & Co.	Holyoke	8.98	9.80	2.68	2.75	15.80	14.00
Sterling, John F. Hunt	Lynn	10.36	9.80	3.46	2.75	15.22	14.00
Sterling, Glen Mills Cereal Co.	Rowley	9.28	9.80	3.33	2.75	14.85	14.00
Meech & Stoddard, Middletown, Conn.							
Connecticut, Jacobson Bros.	N. Dartmouth	9.37	9.80	2.82	2.75	18.23	14.00

ADULTERATED WHEAT FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
J. E. Soper Co., Boston, Mass.							
Kennebec, ...McKenzie & Winslow	Fall River	10.47	10.00	2.89	3.00	13.40	14.00
Kennebec, ...Dennison Plummer Co. ...	New Bedford .	9.94	9.80	3.02	2.75	16.32	14.00
A. Waller & Co., Henderson, Ky.							
Blue Grass, ...G. M. Foster	Lowell........	10.55	9.00	2.73	2.00	14.27	17.00
Blue Grass, ...Milford Grain Co.	Milford	10.12	9.00	2.82	2.00	14.10	17.00
Blue Grass, ...Guay Bros.	New Bedford .	10.16	9.00	2.82	2.00	16.11	15.00

DAIRY FEEDS.

Definition. Dairy feeds are proprietary feeds consisting of a mixture of several feeding stuffs and containing 15 or more per cent protein.

J. Bibby & Sons, Liverpool, England.							
Oilcake Feed ......J. Loring & Co.	Watertown....	18.74	16.00	6.80	7.00	8.18	—
Oilcake Feed,......J. Loring & Co.	Watertown....	19.92	16.00	7.73	7.00	8.63	—
J. W. Biles & Co., Cincinnati, Ohio.							
Union Grains, ...W. N. Potter Sons & Co. .	Hadley	24.69	24.00	6.68	7.00	8.75	8.00
Union Grains, ...E. A. Cowee	Jefferson	25.61	24.00	7.36	7.00	9.78	9.00
Union Grains, ...Bryant & Soule	Middleboro ...	25.18	24.00	7.39	7.00	9.05	9.00
Union Grains, ...Guay Bros.	N. Bedford ...	24.30	24.00	7.57	7.00	6.03	9.00
Union Grains, ...Cutler Grain Co.	S. Framingham	25.04	24.00	6.00	7.00	8.10	9.00
Union Grains, ...Cutler Grain Co.	S. Framingham	23.73	24.00	7.12	7.00	8.52	9.00
Union Grains, ...P. W. Eaton & Co.	Williamstown .	25.44	24.00	6.93	7.00	9.20	9.00
Union Grains, ...J. Cushing & Co.	Winchendon ..	25.18	24.00	7.49	7.00	8.52	9.00
Buffalo Cereal Co., Buffalo, N. Y.							
Creamery Feed, ...J. H. Nye	Brockton	20.62	18.00	4.96	4.00	8.93	8.00
Creamery Feed, ...J. H. Nye	Brockton	20.10	18.00	4.40	4.00	11.55	8.00
Creamery Feed, ...A. Culver Co............	Rockland	20.62	18.00	4.64	4.00	9.33	8.00
Chapin & Co., Hammond, Ind.							
Unicorn, ...Hoosac Val. Coal & Gr. Co.	Adams	26.34	26.00	5.20	5.50	9.78	9.00
Unicorn, ...C. S. Barber	Bernardston...	27.06	26.00	5.12	5.50	9.55	10.00
Unicorn, ...J. Burkhardt	Beverly.......	30.26	26.00	5.57	5.50	9.75	10.00
Unicorn, ...J. Burkhardt	Beverly.......	25.13	26.00	5.25	5.50	8.44	9.00
Unicorn, ...W. A. Haynes Co., Inc. ..	Maynard	26.06	26.00	7.93	5.50	9.20	9.00
Unicorn, ...W. N. Potter Grain Co. ..	Princeton	23.15	26.00	6.83	5.50	9.63	9.00
Chas. M. Cox Co., Boston, Mass.							
Wirthmore, ...Eastern Grain Co.	Bridgewater ..	25.31	26.00	4.37	5.00	8.91	—
Wirthmore, ...C. H. Laflin	Brookfield	26.40	25.50	4.42	5.20	9.75	9.00
Wirthmore, ...C. Bond, ...	Charlton......	26.58	26.00	4.36	5.00	9.48	—
Wirthmore, ...W. J. Meek	Fall River	27.28	26.00	4.11	5.00	8.85	—
Wirthmore, ...A. H. Wood & Co.	Framingham ..	27.82	26.00	5.10	5.00	8.32	—
Wirthmore, ...H. Bruckman	S. Lawrence ..	25.00	26.00	4.51	5.00	9.60	—
Wirthmore, ...Warner Bros.	Sunderland ...	25.09	25.50	4.75	5.20	10.10	9.00
Wirthmore, ...P. W. Eaton & Co.	Williamstown .	25.70	25.50	6.53	5.20	9.57	9.00
Wm. S. Hills Co., Boston, Mass.							
Purity, ...H. J. Williams	Lowell........	26.53	26.00	5.57	8.00	7.99	9.00
H. O. Co., Buffalo, N. Y.							
Algrane, ...Lenox Coal & Grain Co. ..	Lenox	15.55	14.00	3.75	4.00	10.48	9.00
Husted Milling Co., Buffalo, N. Y.							
H. L. Patrick	Hopedale	23.64	18.00	5.29	4.00	7.78	9.00

DAIRY FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Northwest Mills Co., Winona, Minn.							
Milk Meal, ...W. A. Haynes Co., Inc. ..	Maynard	25.44	25.00	2.90	6.00	11.35	9.00
Purina Mills, St. Louis, Mo.							
Protena, ...D. B. Hodgkins Sons	Gloucester	19.75	20.00	4.48	3.50	9.40	14.00

MOLASSES FEEDS.

Definition. Molasses feeds are mixtures of molasses, low grade milling offal and high grade feeding stuffs.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Water.	Protein.		Fat.		Fiber.	
			Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%	%
American Milling Co., Chicago, Ill.								
Sucrene, ...J. W. Raymond	Concord	12.55	18.90	16.50	4.86	3.50	9.50	12.00
Sucrene, ...Prentiss, Brooks & Co. .	Easthampton..	11.89	18.32	16.50	4.12	3.50	10.78	12.00
Sucrene, ...Marlboro Grain Co. ...	Marlboro	10.95	16.50	16.50	3.62	3.50	12.10	12.00
Sucrene, ...Milford Grain Co.	Milford	12.03	16.93	16.50	4.60	3.50	9.96	12.00
Sucrene, ...Sprague & Williams ...	S. Framingham	11.77	15.70	16.50	3.53	3.50	10.31	12.00
F. W. Dorr & Co., Newton Center, Mass.								
Harvard, ...F. W. Dorr & Co.	Newton Center	11.96	20.72	18.00	5.20	4.00	8.36	8.00
Harvard, ...F. W. Dorr & Co.	Newton Center	13.75	18.39	18.00	4.13	4.00	6.46	9.00
F. W. Goeke & Co., St. Louis, Mo.								
Holstein, ...J. Burkhardt	Beverly.......	12.40	15.95	15.00	3.51	3.00	8.97	15.00
Great Western Cereal Co., Chicago.								
Daisy, ...A. E. Lawrence & Son .	Ayer	10.60	17.60	15.00	2.19	3.00	9.65	11.00
Husted Milling Co., Buffalo, N. Y.								
Griffin Bros.	Fall River	12.31	23.68	18.00	4.53	4.00	7.96	8.00
C. A. Pierce	Hinsdale	12.67	22.05	18.00	4.18	4.00	8.14	9.00
Prentiss, Brooks & Co.	Holyoke	13.57	19.38	18.00	4.68	4.00	6.74	9.00
H. L. Patrick	Hopedale	12.90	21.18	18.00	4.29	4.00	8.05	9.00
W. G. Horton	Ipswich.......	16.94	18.07	18.00	4.07	4.00	7.37	9.00
W. G. Horton	Ipswich.......	12.65	22.68	18.00	4.72	4.00	8.19	8.00
P. Foisy	New Bedford .	14.84	20.67	18.00	4.42	4.00	6.47	9.00
Prentiss, Brooks & Co.	Westfield	16.39	19.56	18.00	4.52	4.00	7.68	9.00
Chas. A. Krause Milling Co., Milwaukee.								
Badger, ...F. H. Whitaker	E Longmeadow	15.31	16.34	16.00	1.33	2.00	15.24	15.00
Northwest Mills Co., Winona, Minn.								
Sugarota, ...W. N. Potter Grain Co.	Princeton	12.32	17.04	16.50	4.92	3.50	12.33	14.00
Sugarota, ...G. H. Reed	W. Acton	13.79	17.00	16.50	3.42	3.50	12.45	14.00
Quaker Oats Co., Chicago, Ill.								
Blue Ribbon, J. Burkhardt	Beverly.......	10.03	24.23	25.00	3.45	4.50	9.97	9.00
Blue Ribbon, J. H. Nye	Brockton	9.08	26.47	25.00	4.41	4.00	10.05	9.00
Blue Ribbon, C. H. Laflin	Brookfield	10.15	25.30	25.00	3.41	4.50	10.21	9.00
Blue Ribbon, W. O. Gilbert	Lee	10.94	26.51	25.00	4.11	4.00	9.97	9.00
Blue Ribbon, H. Houghton	Millbury......	11.33	24.29	25.00	3.20	4.50	5.92	9.00
Blue Ribbon, C. E. Terry	W. Springfield .	8.93	24.02	25.00	4.45	4.00	11.56	8.00
Quaker, ...E. E. Cole...........	Billerica	8.76	15.08	16.00	3.38	3.50	16.14	12.00
Quaker, ...E. A. Kellogg & Sons ..	Feeding Hills .	10.49	16.88	16.00	3.82	3.50	16.32	12.00
Quaker, ...C. B. Sampson	Holyoke	9.40	16.44	16.00	4.00	3.50	14.50	10.00
Quaker, ...C. B. Sawin & Son	Southboro	9.67	13.13	16.00	5.34	3.50	11.26	12.00

RYE FEEDS.

Definition. Rye feeds are by-products obtained in the manufacture of flour from rye.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Boutwell Milling & Grain Co., Troy, N.Y.							
J. B. Garland & Son	Worcester	17.20	13.50	2.87	3.00	4.38	—
C. G. Burnham	Holyoke	15.50	13.50	3.12	3.00	3.43	—

CALF MEAL.

Definition. Calf meal is a proprietary mixture intended as a feed for young calves.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
J. Bibby & Sons, Liverpool, Eng.							
Cream Equivalent. . J. Loring & Co.	Watertown	15.46	14.00	15.00	14.00	4.75	—
Cream Equivalent, J. Loring & Co.	Watertown	16.42	14.00	13.90	14.00	4.90	—
Blatchford's Calf Meal Factory, Waukegan, Ill.							
Blatchfords, M. C. Richmond	Adams	25.79	25.00	6.05	5.00	6.61	—
Blatchfords, W. E. Bryant & Co.	Brockton	24.08	25.00	4.80	5.00	4.81	5.00
Great Western Cereal Co., Chicago, Ill.							
Gregson's, T. E. Borden	N. Westport	26.93	25.00	6.30	5.00	4.43	5.00
Quaker Oats Co., Chicago, Ill.							
Schumachers, W. E. Bryant & Co.	Brockton	20.93	19.00	8.05	8.00	3.04	3.00

MISCELLANEOUS PROTEIN FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Atwood Stone Co., Minneapolis, Minn.							
*Cracker Jack, J. Shea	Lawrence	15.03	15.00	6.86	—	11.45	—
J. Bibby & Sons, Liverpool, Eng.							
Oilcake horse feed, J. Loring & Co.	Watertown	17.65	16.00	8.10	7.00	8.03	—
Oilcake horse feed, J. Loring & Co.	Watertown	19.57	16.00	6.78	7.00	8.00	—
Pig Meal, J. Loring & Co.	Watertown	13.44	13.00	5.52	6.00	7.95	—
Pig Meal, J. Loring & Co.	Watertown	14.45	13.00	6.47	6.00	8.78	—
Corn Products Refining Co., New York.							
Argo Corn Oil Meal, W. L. Palmer	Medway	20.49	19.00	7.32	7.50	8.85	15.00
Henry Jennings, Boston, Mass.							
**H. S. Flax Feed, Smith Feed Co.	Westfield	16.69	18.00	14.22	15.00	12.25	8.38
Lexington Grain Co., Lexington, Mass.							
Hog Food, Lexington Grain Co.	Lexington	25.48	5.00	4.51	2.00	5.33	—

*A mixture of flaxseed screenings and wheat screenings.

**Flax seed screenings.

II. STARCHY (CARBOHYDRATE) FEEDS.

CORN MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Water.	Protein.	Fat.	Fiber.
		%	%	%	%
Ground by Retailer.					
E. J. Adams	Gt. Barrington	19.37	8.14	4.43	1.53
C. S. Barber	Bernardston	19.52	8.69	3.42	2.02
Bryant & Soule	Middleboro	12.85	9.33	4.04	1.80
J. B. Bridges & Co.	S. Deerfield	20.15	8.54	3.46	2.04
C. G. Burnham	Holyoke	19.27	8.78	3.53	2.07
E. A. Cole	Housatonic	20.61	8.44	2.96	1.57
F. G. Cover & Co.	Lowell	12.48	9.15	3.85	1.93
Dresser Hull Co.	Lee	17.14	8.54	3.43	1.90
P. W. Eaton & Co.	Williamstown	21.13	8.38	3.25	2.33
J. O. Ellison & Co.	Haverhill	12.81	8.98	3.96	2.20
F. A. Fales & Co.	Norwood	17.57	9.03	2.06	1.67
F. A. Fales & Co.	Norwood	12.43	9.28	3.97	2.63
G. F. Greene Coal Co.	Campello	12.98	8.98	3.57	3.19
Hingham Grain Mill Inc.	Hingham	13.16	8.98	3.97	1.47
Hingham Grain Mill Inc.	Hingham	20.31	7.41	2.65	1.48
D. B. Hodgkins Sons	Gloucester	13.12	8.76	3.99	1.94
J. F. Hunt	Lynn	13.42	8.84	3.70	1.17
McKenzie & Winslow	Fall River	19.85	8.13	3.37	1.52
McKenzie & Winslow	Fall River	12.94	8.98	3.96	1.66
W. J. Meek	Fall River	21.54	8.65	3.41	1.66
Morse Bros.	Southbridge	21.14	8.37	2.72	1.45
I. Morton Co.	Plymouth	13.49	9.07	3.73	1.44
J. H. Nye	Brockton	12.77	10.16	4.01	2.03
E. C. Packard	Brockton	19.48	8.52	3.31	1.31
B. E. C. Packard	Brockton	12.81	9.37	3.87	1.04
C. O. Parmenter & Co.	S. Sudbury	12.96	9.17	4.80	1.95
Prentiss, Brooks & Co.	Holyoke	14.60	8.61	3.80	2.12
Prentiss, Brooks & Co.	Westfield	19.94	8.70	3.48	1.55
Smith Feed Co.	Westfield	20.79	8.55	3.72	1.77
C. N. Upham	Foxboro	12.84	9.24	3.92	1.78
Warren Grain Co.	Warren	13.28	9.00	4.09	1.98
M. G. Williams	Raynham	13.05	9.07	4.40	1.65
M. G. Williams	Raynham	19.31	8.36	3.65	1.57
F. F. Woodward & Co.	Fitchburg	13.37	9.30	3.63	2.45
E. W. Bailey & Co., Montpelier, Vt.					
J. E. Merrick & Co.	Amherst	20.26	8.68	2.47	1.90
Buffalo Cereal Co., Buffalo, N. Y.					
Mohawk, T. H. Emerson	Weymouth	13.05	9.11	4.65	0.95
Mohawk, F. H. Crane & Co.	Quincy Adams	18.22	8.05	2.08	0.71
E. A. Cowee, Worcester.					
E. A. Cowee	Jefferson	20.69	8.79	3.91	2.23
E. Crosby & Co., Brattleboro, Vermont.					
N. Hatfield Grain Co.	N. Hatfield	15.67	8.57	4.70	3.49
Cutler Grain Co., North Wilbraham.					
G. W. Reynolds Co.	Chelsea	13.27	9.34	3.67	2.67
W. O. Gilbert	Lee	19.81	8.37	3.23	2.23
Milford Grain Co.	Milford	13.48	9.66	3.88	2.36
Elmore Milling Co., Oneonta, N. Y.					
Western Coal & Grain Co.	N. Adams	19.68	8.53	4.06	1.73
Wm. S. Hill Co., Boston, Mass.					
W. H. Garland	Gloucester	13.91	9.32	4.35	2.05
Hobart Mills, Weymouth, Mass.					
C. S. Tarbox	Weymouth	13.00	10.07	4.46	1.65
Husted Milling Co., Buffalo, N. Y.					
Hoosac Valley Coal & Grain Co.	Adams	19.06	7.90	2.61	0.96

CORN MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Water.	Protein.	Fat.	Fiber.
		%	%	%	%
Meech & Stoddard, Middletown, Conn.					
Horvitz Grain Co.	New Bedford	12.98	9.11	2.33	1.96
Mollett Grain Co., McClure, Ohio.					
AAA, Robinson, Jones Co.	Natick	15.42	8.51	3.09	1.07
Narragansett Milling Co., E. Providence, R. I.					
A, Taunton Grain Co.	Taunton	20.66	7.89	3.50	2.17
A, Taunton Grain Co.	Taunton	12.83	9.33	4.05	2.40
B, Taunton Grain Co.	Taunton	13.24	9.07	3.57	2.26
B, A. Culver Co.	Rockland	12.89	9.15	3.58	2.21
W. N. Potter & Sons, Greenfield, Mass.					
A. D. Potter	Orange	21.34	8.39	3.48	1.78
Quaker Oats Co., Chicago, Ill.					
Golden, Butman & Cressey	Lynn	14.02	8.89	2.78	0.39
Stratton & Co., Concord, N. H.					
I. J. Rowell	Pepperell	12.85	9.46	3.80	1.79
H. K. Webster Co., Lawrence, Mass.					
H. Bruckman	Lawrence	12.48	9.46	4.97	2.56
Average—Fall Collection		13.26	9.17	3.91	1.95
Average—Winter Collection		19.86	8.41	3.26	1.71

GROUND OATS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Water.	Protein.	Fat.	Fiber.
Ground by Retailer.					
E. J. Adams	Gt. Barrington	—	13.58	2.97	10.28
Hingham Grain Mill Inc.	Hingham	—	12.83	4.07	9.85
Hingham Grain Mill Inc.	Hingham	—	11.91	4.91	9.52
W. H. Horton	Ipswich	—	12.94	4.03	9.08
J. H. Nye	Brockton	—	12.69	5.24	7.75
E. C. Packard	Brockton	—	13.71	4.82	10.60
C. O. Parmenter & Co.	S. Sudbury	—	12.65	4.68	9.45
Smith Feed Co.	Westfield	—	11.78	4.18	8.10
M. G. Williams	Raynham	—	12.69	4.38	10.27
M. G. Williams	Raynham	—	12.96	4.67	10.25
Smith, Northam & Co., Hartford, Conn.					
J. F. Ray	Franklin	—	12.43	4.33	12.30
J. F. Ray	Franklin	—	11.38	4.09	9.30
Stratton & Co., Concord, N. H.					
I. J. Rowell	Pepperell	—	12.61	4.31	9.75
F. F. Woodward & Co., Fitchburg, Mass.					
Blood Bros.	Medfield	—	13.40	4.05	8.34
J. Franks	New Bedford	—	12.92	3.42	10.50

RYE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Water.	Protein.	Fat.	Fiber.
E. C. Packard, Brockton, Mass.					
E. C. Packard	Brockton	—	10.20	1.81	1.75
E. C. Packard	Brockton	—	12.13	1.65	2.00

HOMINY MEAL.

Definition. Hominy meal, feed or chop is a by-product in the manufacture of hominy grits from corn, and consists of the hull and corn germ together with a considerable portion of the corn starch.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
American Hominy Co., Indianapolis, Ind.							
Homco, ...C. O. Parmenter & Co. ...	S. Sudbury....	10.68	9.50	6.92	7.00	3.53	7.00
M. F. Baringer, Philadelphia, Penn.							
Mansfield Milling Co......	Mansfield	10.59	9.00	4.28	6.00	3.80	10.00
T. E. Borden	N. Westport ..	10.99	9.00	7.77	6.00	3.95	10.00
Buffalo Cereal Co., Buffalo, N. Y.							
C. P. McClanathan.......	Barre Plains ..	10.73	10.00	9.63	7.00	4.20	4.00
F. Knight	Charlton Depot	10.16	10.00	7.62	7.00	3.63	4.00
Griffin Bros.	Fall River ...	10.77	10.00	8.05	7.00	4.21	4.00
Griffin Bros.	Fall River	10.51	10.00	5.30	7.00	3.65	4.00
W. N. Potters Sons	Springfield ...	10.82	10.00	7.98	7.00	3.38	4.00
S. B. Green Co.	Watertown....	10.38	10.00	7.77	7.00	3.37	4.00
Chapin & Co., Hammond, Ind.							
Green Diamond, ..Hoosae Val. Coal & Gr. Co.	Adams	10.73	10.00	8.10	7.00	3.85	5.00
Chas. M. Cox Co., Boston, Mass.							
Wirthmore, ...M. C. Richmond	Adams	11.17	9.50	9.00	7.50	5.25	—
Wirthmore, ...Scott Grain Co.	Amesbury	10.24	9.50	7.63	7.50	3.61	—
Wirthmore, ...J. H. Nye	Brockton	11.03	9.50	8.32	7.50	1.76	—
Wirthmore, ...Bosworth & Son	Leominster....	10.66	9.50	7.52	7.50	3.73	—
Wirthmore, ...Milford Grain Co.	Milford	11.29	9.50	8.00	7.50	3.35	—
Wirthmore, ...F. Diehl & Son	Wellesley	10.33	9.50	7.17	7.50	3.73	—
Elevator Milling Co., Springfield, Ill.							
Ideal, ...C. Bond	Charlton......	11.25	11.02	9.32	7.70	4.73	—
Ideal, ...Blood Bros.	Medfield	11.34	11.02	9.56	7.70	4.35	—
Ideal, ...Thorne Bros.	Millis	11.08	11.02	10.38	7.70	4.27	—
Evans Milling Co., Indianapolis, Ind.							
Evans, ...G. M. Foster	Lowell........	10.82	10.00	7.27	7.50	3.20	7.00
Evans, ...J. F. Hunt	Lynn	10.52	10.00	8.67	7.50	4.83	7.00
W. H. Haskell & Co., Toledo, Ohio.							
F. Gauvin..............	Marlboro	10.82	10.25	7.72	8.10	3.02	—
Charles Herendeen Milling Co., Chicago, Ill.							
W. K. Gilmore & Sons ...	Walpole	11.08	10.15	8.87	6.40	4.00	3.55
Hunter-Robinson-WenzMilling Co., St. Louis, Mo.							
Capital, ...E. A. Cowee	Jefferson	9.77	11.02	4.98	7.78	3.73	—
Capital, ...H. Houghton	Millbury......	9.24	11.02	5.83	7.78	5.48	—
Capital, ...Thorne Bros.	Millis	9.37	9.85	4.83	7.78	3.20	11.02
Husted Milling Co., Buffalo, N. Y.							
Yellow, ...A. C. Boice	Conway	10.90	9.00	7.07	6.00	4.00	8.00
Chas. A. Krause Milling Co., Milwaukee, Wis.							
Badger, ...McKenzie & Winslow	Fall River	12.08	9.00	7.80	6.00	3.13	5.00
H. C. McEachron Co., Wausau, Wis.							
J. Shea	Lawrence	10.73	11.00	8.17	8.50	3.13	4.00
Miner-Hillard Milling Co., Wilkes-Barre, Pa.							
C. P. McClanathan.......	Barre Plains ..	11.60	10.00	5.57	7.50	3.42	5.00
W. E. Bryant & Co.	Brockton	10.24	10.00	6.77	7.50	4.15	5.00
McKenzie & Winslow	Fall River	10.73	10.00	6.43	7.50	3.10	5.00

HOMINY MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Miner-Hillard Milling Co. (Cont.)							
W. N. Potters Sons & Co.	Hadley	10.90	10.00	6.33	7.50	3.38	5.00
Bowen & Fuller	Leominster	11.35	10.00	6.57	7.50	4.15	5.00
Bowen & Fuller	Leominster	10.55	10.00	5.60	7.50	2.90	5.00
A. Altman	New Bedford	10.55	10.00	7.06	7.50	3.96	5.00
I. J. Rowell	Pepperell	11.69	10.00	5.72	7.50	3.30	5.00
Patent Cereals Co., Geneva, N. Y.							
W. N. Potter Grain Co.	Princeton	10.68	10.00	7.96	7.00	3.60	5.00
Dodge Mill Co.	Saundersville	10.59	10.00	7.97	7.00	3.95	5.00
J. B. Garland & Son	Worcester	10.94	10.00	7.87	7.00	3.89	5.00
J. E. Soper Co., Boston, Mass.							
Blue Ribbon, Glen Mills Cereal Co.	Rowley	11.08	10.00	7.68	8.00	4.15	—
Blue Ribbon, Glen Mills Cereal Co.	Rowley	10.63	10.00	8.01	8.00	3.55	—
Blue Ribbon, A. N. Whittemore & Co.	Worcester	10.77	10.00	8.17	7.00	3.80	5.00
Sparr Cereal Co., Marshfield, Wis.							
J. Shea	Lawrence	11.34	10.00	9.84	8.00	4.36	7.00
Standard Cereal Co., Chillicothe, Ohio.							
Standco, McKenzie & Winslow	Fall River	10.82	10.00	7.97	7.00	1.90	4.00
Standco, Howe Bros.	Gardner	11.21	10.00	7.90	7.00	2.73	4.00
Standco, W. Livingston	Lowell	9.86	10.00	6.10	7.00	1.29	4.00
Standco, G. H. Reed	W. Acton	10.64	10.00	7.98	7.00	2.23	4.00
Suffern, Hunt & Co., Decatur, Ill.							
Acme, C. Bond	Charlton	11.21	9.30	8.72	7.10	4.67	10.00
Acme, Lummus & Parker	Danversport	10.86	9.30	9.29	7.10	4.87	10.00
Toledo Elevator Co., Indianapolis, Ind.							
*Star Feed, J. Shea	Lawrence	9.11	7.00	5.60	5.50	7.85	12.50
*Star Feed, Strong Grain Co.	New Bedford	9.37	7.00	7.26	5.50	9.30	12.50
*Star Feed, Curley Bros.	Wakefield Jct.	8.89	7.00	6.40	5.50	9.30	12.50

*Contains ground corn cob.

PROVENDER.

Definition. Provender is a mixture of straight corn and oats ground together.

Ground by Retailer.							
E. J. Adams	Gt. Barrington	10.42	—	3.93	—	3.20	—
E. A. Cole	Housatonic	11.29	—	4.05	—	5.50	—
E. A. Cowee	Worcester	10.99	8.00	4.13	3.00	5.33	—
F. A. Fales & Co.	Norwood	10.86	—	3.32	—	8.75	—
F. A. Fales & Co.	Norwood	10.24	—	3.25	—	4.55	—
W. Livingston	Lowell	8.14	10.00	3.93	3.00	8.28	—
E. C. Packard	Brockton	10.47	—	4.10	—	5.30	—
Plummer&JenningsGr. Co.	New Bedford	10.38	—	4.17	—	9.30	—
W. N. Potters Sons	Springfield	12.74	—	2.65	—	9.65	—
C. H. Smith	Dighton	11.56	—	4.71	—	6.99	—
M. G. Williams	Raynham	10.64	—	4.57	—	4.33	—
M. G. Williams	Raynham	10.20	—	3.73	—	4.55	—
E. A. Cowee, Worcester, Mass.							
I. J. Rowell	Pepperell	11.03	9.00	3.40	3.00	4.77	—
I. J. Rowell	Pepperell	10.86	9.00	3.23	3.00	4.88	—
Elmore Milling Co., Oneonta, N. Y.							
Western Coal & Grain Co.	No. Adams	10.24	—	4.80	—	4.40	—

PROVENDER (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Husted Milling Co., Buffalo, N. Y.							
Steam Cooked Feed, Prentiss Brooks & Co.	Easthampton..	10.90	8.00	4.37	4.00	5.48	6.00
Steam Cooked Feed, P. Foisey................	New Bedford .	9.68	9.00	4.23	4.00	5.45	8.00
Steam Cooked Feed, F. H. Crane & Sons	Quincy Adams	10.82	9.00	3.87	4.00	2.35	6.00
Steam Cooked Feed, Ropes Bros.	Salem	9.98	9.00	4.29	4.00	4.54	6.00
Steam Cooked Feed, Prentiss, Brooks & Co.	Westfield	10.73	9.00	4.40	4.00	5.65	6.00
Imperial Grain & Milling Co., Toledo, Ohio.							
Imperial, ...Torrence Vary & Co.	Lynn	10.16	9.50	4.63	4.00	2.82	4.00
Imperial, ...S. B. Green & Co.	Watertown....	9.94	9.50	4.45	4.00	3.07	4.00
Narragansett Milling Co., E. Providence, R. I.							
Taunton Teaming Co.	Taunton	10.42	9.50	3.22	3.50	3.78	—
Smith, Northam Co., Hartford, Conn.							
J. F. Ray	Franklin	10.03	9.00	4.85	4.00	4.63	—
J. F. Ray	Franklin	9.72	9.00	3.17	4.00	5.23	—
Stratton & Co., Concord, N. H.							
I. J. Rowell	Pepperell	10.77	—	3.34	—	7.55	—

STOCK AND HORSE FEEDS. (Containing less than 12% protein.)

Definition. Proprietary mixtures consisting largely of oat by-products, corn and sometimes other material.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber Found.	Fiber Guar.
Amendt Milling Co., Monroe, Mich.							
Amco, ...Rollstone Grain Co.	Fitchburg	10.24	7.00	4.46	3.82	6.60	10.90
Amco, ...Rollstone Grain Co.	Fitchburg	11.43	7.87	4.83	3.92	6.03	10.95
Amco, ...C. L. Marsh	Webster	10.82	7.87	6.45	3.82	14.33	12.00
Wm. C. Brett, No. Abington, Mass.							
Alright, ...W. C. Brett	N. Abington ..	9.40	9.00	6.08	4.00	7.79	—
Buffalo Cereal Co., Buffalo, N. Y.							
Chop, ...G. W. Reynolds & Son ...	Chelsea	8.32	7.00	3.54	3.00	11.98	9.00
Chop, ...A. Altman...............	New Bedford .	8.41	7.00	3.87	3.00	11.89	9.00
Chop, ...Horvitz Grain Co.	New Bedford .	8.23	7.00	4.10	3.00	7.77	9.00
Chop, ...J. Loring & Co.	Watertown....	7.62	7.00	3.99	3.00	13.00	9.00
Horse, ...Griffin Bros.	Fall River	11.38	10.00	4.38	4.00	9.00	8.00
Horse, ...G. M. Foster	Lowell........	11.87	10.00	4.57	4.00	5.60	8.00
Horse, ...Butman & Cressey	Lynn	11.78	10.00	4.52	4.00	6.93	8.00
Horse, ...A. Culver Co............	Rockland	11.99	10.00	4.27	4.00	9.68	8.00
Stock, ...T. H. Emerson...........	E. Weymouth .	9.24	8.00	4.88	4.00	7.72	9.00
Stock, ...Morse Bros.	Southbridge ..	9.89	8.00	5.10	4.00	9.78	9.00
Chesbro Milling Co., Salamanca, N. Y.							
Chesbro's, ...J. B. Bridges & Co........	S. Deerfield ...	9.02	10.00	3.57	3.25	5.10	7.00
Chas. M. Cox Co., Boston, Mass.							
Charlestock,.......W. R. Ross & Co.	Holyoke	8.67	6.00	5.20	3.00	10.58	—
Wirthmore, ...Scott Grain Co.	Amesbury	9.28	9.00	6.73	4.00	6.93	—
Wirthmore, ...C. P. McClanathan.......	Barre Plains ..	10.07	9.00	6.43	4.00	6.20	—
Wirthmore, ...F. F. Woodward & Co. ...	Fitchburg	9.24	9.00	5.73	4.00	6.48	7.00
Wirthmore, ...Bowen & Fuller	Leominster....	9.54	9.00	4.83	4.00	5.34	—
Wirthmore, ...Whitney Coal & Grain Co.	N. Adams ...	9.42	9.00	5.33	4.00	5.33	7.00
J. Cushing & Co., Hudson, Mass.							
Hudson, ...J. Cushing & Co.	Hudson.......	9.63	9.50	6.18	4.00	7.35	—
Hudson, ...J. Cushing & Co.	Hudson.......	9.50	10.00	4.78	4.00	4.67	—
Hudson, ...F. Gauvin	Marlboro	9.72	10.00	5.42	4.00	8.33	—

STOCK AND HORSE FEEDS (Containing less than 12% protein.) (Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
			%	%	%	%	%	%
F. W. Dorr & Co., Newton Center, Mass.								
Matchless,	F. W. Dorr & Co.	Newton Center	9.94	10.00	7.02	4.00	6.64	—
Matchless,	F. W. Dorr & Co.	Newton Center	8.41	10.00	3.30	4.00	5.00	—
Empire Mills, Olean, N. Y.								
Empire,	Guay Bros.	New Bedford	9.23	7.50	4.27	3.00	5.51	9.00
Empire,	Guay Bros.	New Bedford	8.54	7.50	3.57	3.00	6.55	9.00
J. B. Garland & Son, Worcester, Mass.								
Red Tag A,	Bond Grain Co.	Charlton	10.07	7.00	4.74	3.00	12.05	—
Red Tag A,	H. Houghton	Millbury	10.59	7.00	4.73	3.00	10.53	—
Red Tag A,	J. B. Garland & Son	Worcester	11.03	7.00	4.67	3.00	12.44	—
Red Tag B,	Brown Bros.	Northbridge	9.81	7.00	4.02	3.00	14.35	—
D. H. Grandin Milling Co., Jamestown, N. Y.								
Grandins,	A. Dodge Sons Corp.	Beverly	8.54	10.00	3.00	4.40	5.50	8.21
Grandins,	McKenzie & Winslow	Fall River	9.93	8.50	3.30	3.50	9.25	9.00
Grandins,	J. Shea	Lawrence	8.84	10.00	2.90	4.40	5.80	8.21
Grandins,	Knight Grain Co.	Newburyport	9.89	8.50	3.28	3.50	4.10	9.00
Grandins,	A. N. Whittemore	Worcester	8.49	10.00	3.27	4.40	8.00	8.21
Great Western Cereal Co., Chicago, Ill.								
Sterling,	C. Bond	Charlton	10.99	10.00	3.54	4.00	5.72	10.00
W. H. Haskell & Co., Toledo, Ohio.								
Haskells,	Rollstone Grain Co.	Fitchburg	9.86	8.00	6.42	4.00	6.65	8.00
Haskells,	Milford Grain Co.	Milford	9.50	8.00	7.43	4.00	6.77	8.00
Haskells,	F. Gauvin	Marlboro	9.93	8.00	6.76	4.00	6.82	8.00
Haskells,	Robinson, Jones & Co.	Natick	10.07	8.00	7.10	4.00	4.70	8.00
Haskells,	Strong Grain Co.	New Bedford	10.24	8.00	7.74	4.00	7.23	8.00
Wm. S. Hills Co., Boston, Mass.								
Purity,	C. T. Wyman	Hubbardston	8.67	8.50	3.84	3.00	6.97	6.00
Purity,	Thatcher & Ireland	Littleton	9.59	10.00	3.32	3.25	8.00	9.00
Purity,	G. Methe & Son	Springfield	8.93	8.50	3.50	3.00	3.55	5.00
H. O. Co., Buffalo, N. Y.								
Algrane Horse,	Lenox Coal & Grain Co.	Lenoxdale	10.93	11.00	5.32	4.00	4.43	9.00
Algrane Horse,	Knight Grain Co.	Newburyport	9.59	11.00	3.50	4.00	6.75	9.00
Algrane Horse,	Knight Grain Co.	Newburyport	9.70	11.00	3.62	4.00	8.90	9.00
Algrane Horse,	S. L. Davenport & Son	N. Grafton	11.17	11.00	3.77	4.00	10.05	9.00
Algrane Horse,	Beaver Coal & Grain Co.	Norwood	10.24	11.00	3.87	4.00	9.27	9.00
Algrane Horse,	Beaver Coal & Grain Co.	Norwood	10.93	11.00	4.07	4.00	9.30	9.00
De Fi,	Knight Grain Co.	Newburyport	7.53	8.00	3.30	3.00	9.89	21.00
De Fi,	J. Paull & Co.	Taunton	8.32	8.00	2.55	3.00	11.46	21.00
N. E. S. F.,	Rollstone Grain Co.	Fitchburg	8.93	9.00	3.73	4.00	9.33	9.00
N. E. S. F.,	C. G. Burnham	Holyoke	8.53	9.00	3.60	4.00	9.55	9.00
N. E. S. F.,	Beaver Coal & Grain Co.	Norwood	8.78	9.00	4.16	4.00	11.11	9.00
N. E. S. F.,	S. L. Davenport & Son	Norwood	9.85	9.00	4.73	4.00	8.93	12.00
N. E. S. F.,	J. S. Nason & Co.	Westboro	9.54	9.00	4.05	4.00	9.35	9.00
John F. Hunt, Lynn, Mass.								
Special Provender,	J. F. Hunt	Lynn	11.86	—	4.45	—	5.06	—
Husted Milling Co., Buffalo, N. Y.								
Husted,	Hoosac Val. Coal & Gr. Co.	Adams	10.64	8.00	6.15	4.00	6.59	—
Mayflower,	Bedford Coal & Grain Co.	Bedford	9.77	7.50	5.47	3.50	8.77	9.00
Monarch,	E. J. Adams	Gt. Barrington	9.89	7.50	4.43	3.50	5.50	9.00
Imperial Grain & Milling Co., Toledo, Ohio.								
Corn, oat & barley,	Mansfield Milling Co.	Mansfield	9.94	8.90	6.55	3.70	10.60	11.75
Lexington Grain Co., Lexington, Mass.								
Alfalfa Stock,	Lexington Grain Co.	Lexington	11.91	8.00	4.25	2.00	9.46	—

STOCK AND HORSE FEEDS (Containing less than 12% protein). (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Meech & Stoddard, Middletown, Conn.							
M & S, Jacobson Bros.	N. Dartmouth	10.29	9.00	6.52	3.00	6.42	—
M & S, Weld & Beck	Southbridge	10.20	9.00	5.40	3.00	8.00	—
Mollett Grain Co., Frankfort, Ind.							
Park city chops, J. Shea	Lawrence	9.33	8.00	5.55	3.50	7.55	10.00
Quaker Oats Co., Chicago, Ill.							
Boss, G. F. Wetherbee Co.	Gardner	7.75	8.00	3.25	3.50	8.23	11.00
Schumachers, C. H. Pierce	Hinsdale	11.47	10.00	3.70	3.25	8.25	10.00
Schumachers, T. E. Borden	N. Westport	9.63	10.00	3.60	3.50	8.35	10.00
Schumachers, W. N. Potter Grain Co.	Princeton	11.63	10.00	3.07	3.25	8.43	10.00
Schumachers, A. Milot & Son	Taunton	10.24	10.00	3.53	4.00	9.15	10.00
Schumacher Horse, Wallace Grain Co.	Clinton	9.98	9.25	3.62	3.25	6.40	8.00
Schumacher Horse, C. A. Pierce	Hinsdale	9.77	9.25	3.87	3.25	7.35	8.00
Schumacher Horse, Torrence Vary & Co.	Lynn	9.33	9.25	3.90	3.25	6.75	8.00
Schumacher Horse, M. H. Rolfe Est.	Newburyport	9.54	9.25	3.75	3.25	6.87	8.00
Sterling, G. F. Wetherbee Co.	Gardner	10.33	10.00	3.17	4.00	9.35	10.00
Victor, W. O. Gilbert	Lee	8.23	8.00	3.53	3.50	9.00	12.00
White Diamond, W. O. Gilbert	Lee	9.33	8.00	4.63	3.25	8.50	9.00
H. K. Webster Co., Lawrence, Mass.							
Stock, F. G. Morey & Co.	Billerica	9.72	8.00	4.50	4.00	6.80	9.00
Stock, F. G. Morey & Co.	Billerica	9.49	8.00	4.36	4.00	7.33	9.00
F. F. Woodward & Co., Fitchburg, Mass.							
Verybest, F. F. Woodward & Co.	Fitchburg	9.37	10.00	5.52	4.00	7.22	—
Verybest, H. W. Hill Est.	Williamsburg	9.63	10.00	7.32	4.00	7.33	—

STOCK AND HORSE FEEDS (12-15% protein.)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Amendt Milling Co., Monroe, Mich.							
Amco, Worcester Hay & Grain Co.	Worcester	12.04	7.97	6.43	3.92	5.73	10.95
Buffalo Cereal Co., Buffalo, N. Y.							
Dairy, H. L. Patrick	Hopedale	13.62	12.00	4.57	3.00	9.63	—
J. Burkhardt, Beverly, Mass.							
Colonial, J. Burkhardt	Beverly	13.75	12.00	3.72	6.00	7.13	—
Colonial, J. Burkhardt	Beverly	14.54	12.00	4.37	6.00	8.80	—
Husted Milling Co., Buffalo, N. Y.							
Husted Horse, W. K. Gilmore & Sons	Walpole	13.14	12.00	4.67	4.00	5.20	9.00
Lexington Grain Co., Lexington, Mass.							
Alfalfa Horse, Lexington Grain Co.	Lexington	12.69	9.00	5.57	2.00	8.05	—
Alfalfa Horse, Lexington Grain Co.	Lexington	14.08	11.00	5.73	3.00	7.20	—
Ropes Bros., Salem, Mass.							
Horse, Ropes Bros.	Salem	14.63	16.00	5.97	5.00	5.47	—

DRIED BEET PULP.

Definition. Dried beet pulp is the dried sugar beet residue obtained in the manufacture of beet sugar.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Larrowe Milling Co., Detroit, Mich.							
E. A. Cole	Billerica	8.08	8.00	0.68	0.50	18.55	20.00
J. N. Waite	Easthampton	9.63	8.00	0.98	0.50	18.78	20.00
F. H. Whitaker	E Longmeadow	9.42	8.00	0.40	0.50	17.85	20.00
McKenzie & Winslow	Fall River	9.24	8.00	0.47	0.50	17.08	20.00
Glen Mills Cereal Co.	Rowley	7.79	8.00	0.70	1.00	[illegible]	20.00
J. B. Bridges & Co.	S. Deerfield	9.72	8.00	0.45	0.50	18.80	20.00
W. K. Gilmore & Sons	Walpole	8.10	8.00	0.90	0.50	18.03	20.00

MOLASSES FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Water.	Protein.		Fat.		Fiber.	
			Found.	Guar.	Found.	Guar.	Found.	Guar.
American Milling Co., Chicago, Ill.		%	%	%	%	%	%	%
Sucrene Horse, .G. Methe & Sons ...	Springfield ...	14.70	11.25	10.00	2.99	3.50	8.91	12.00
Edward S. Emory, Boston, Mass.								
Molassine, ...I. Morton & Co.	Plymouth	24.71	8.91	7.00	0.36	0.50	5.44	—
Husted Milling Co. Buffalo, N. Y.								
Alfalfa Horse, .Bedford Coal&Gr.Co.	Bedford	17.86	12.82	10.00	3.42	2.00	6.52	15.00
Alfalfa Horse, .R. W. Davies	Greenfield	15.22	12.09	10.00	3.96	3.00	7.66	15.00
Germaline, ...Bedford Coal&Gr. Co.	Bedford	20.32	9.50	9.00	5.27	3.00	2.09	4.00
Germaline, ...A. Dodge & Sons ..	Beverly.......	12.39	9.26	9.00	2.93	3.00	1.20	—
Germaline, ...W. G. Horton	Ipswich.......	22.33	9.45	9.00	5.40	3.00	2.33	—
M. C. Peters Mill Co., Omaha, Neb.								
Alfal-Fat-Sugar Highland Mills......	Newton H'lnds	19.76	10.46	10.00	0.69	0.50	13.77	26.00
Arab H. Feed, .Highland Mills......	Newton H'lnds	17.53	10.67	9.00	2.52	2.00	8.18	15.00
June Pasture, ..Highland Mills	Newton H'lnds	18.28	11.42	10.00	0.93	0.50	16.67	26.00
Quaker Oats Co., Chicago, Ill.								
Quaker Dairy,..Blood Bros.	Medfield	9.88	14.11	16.00	3.71	3.50	13.29	12.00

MISCELLANEOUS STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
A. H. Brown & Bros., Boston, Mass.		%	%	%	%	%	%
Dried Grains, ...H. H. Crossman	Needham	11.20	10.00	4.01	2.50	12.23	—
Chas. M. Cox Co., Boston, Mass.							
Oat Feed, ...W. J. Meek	Fall River	4.87	5.75	2.13	2.50	23.10	26.00
Oat Feed, ...W. J. Meek	Fall River	5.82	5.75	2.48	2.50	25.18	26.25
Oat Feed, ...W. Livingston	Lowell........	5.48	6.00	3.12	2.00	23.10	—
Oat Feed, ...Whitney Coal & Grain Co.	N. Adams	4.82	6.00	2.05	2.00	27.58	—
F. A. Fales & Co., Norwood, Mass.							
Cracked Corn Sft'gs,F. A. Fales & Co.	Norwood	8.98	—	3.17	—	1.64	—
Glen Mills Cereal Co., Rowley, Mass.							
Corn Bran,........Glen Mills Cereal Co.	Rowley	7.71	7.00	4.96	4.00	11.18	—
Fine Corn Bran, ...Glen Mills Cereal Co.	Rowley	9.62	9.00	6.00	4.00	7.62	—
Coarse Corn Bran, .Glen Mills Cereal Co.	Rowley	9.95	9.00	6.60	4.00	6.72	—
Coarse Corn Bran, .Glen Mills Cereal Co.	Rowley	7.44	7.00	3.29	3.00	9.22	—
Corn Middlings, ...Glen Mills Cereal Co.	Rowley	9.83	12.00	7.29	12.00	2.06	—
Corn Middlings, ...Glen Mills Cereal Co.	Rowley	10.88	10.00	8.17	8.00	4.37	—
Quaker Oats Co., Chicago, Ill.							
Maz-All Corn Feed, A. Dodge & Sons	Beverly.......	7.57	9.50	0.67	1.40	0.28	2.00
Maz-All Corn Feed, G. M. Foster	Lowell	7.84	9.50	2.00	1.40	0.68	2.00
Nathan Tufts & Sons, Charlestown, Mass.							
Damaged C. Meal, .G. M. Foster	Lowell........	9.63	—	3.56	—	3.03	—
Damaged C. Meal, .F. G. Cover & Co.	Lowell........	9.89	—	3.44	—	2.98	—

III. POULTRY FEEDS.

MEAT SCRAPS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Ash.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
First Grade (over 45 per cent Protein).		%	%	%	%	%	%
Beach Soap Co., Lawrence, Mass.							
H. Bruckman	Lawrence	51.58	55.00	26.00	15.00	16.10	—
Albert Culver Co., Rockland, Mass.							
A. Culver Co.	Rockland	45.32	46.00	22.35	19.00	19.36	—
L. T. Frisbee Co., New Haven, Conn.							
Dresser Hull Co.	Lee	48.78	40.00	9.08	8.00	32.76	—
W. D. Higgins, S. Framingham.							
C. G. Jordan	Weymouth	49.13	50.00	18.65	12.00	22.37	—
A. Lord & Co., Chelsea, Mass.							
D. B. Hodgkins Sons	Manchester	53.06	30.00	25.17	17.00	14.59	—
Park & Pollard Co., Boston, Mass.							
Blue Ribbon, ...Bosworth & Son	Leominster	54.10	70.00	12.18	10.00	21.12	—
Portland Rendering Co., Portland, Me.							
Poultry Food, ...M. H. Rolfe Est.	Newburyport	45.53	40.00	11.62	8.00	32.68	—
Richmond Abattoir, Richmond, Va.							
Rava Meat Meal, .Milford Grain Co.	Milford	84.67	85.00	8.15	7.00	2.56	—
Rava Meat Meal, .Lexington Grain Co.	Lexington	85.99	85.00	7.02	7.00	2.23	—
Springfield Rendering Co., Springfield, Mass.							
Poultry Food, ...C. H. Laflin	Brookfield	50.79	40.00	10.28	8.00	26.92	—
H. K. Webster Co., Lawrence, Mass.							
H. K. Webster Co.	Lawrence	44.97	55.00	9.75	12.00	33.06	—
H. K. Webster Co.	Lawrence	52.10	55.00	12.25	12.00	25.36	—
Whitman & Pratt Rendering Co., Lowell, Mass.							
W. N. Potters Sons	Springfield	45.00	40.00	16.48	10.00	26.66	—
Worcester Rendering Co., Auburn, Mass.							
F. F. Woodward & Co.	Fitchburg	47.33	40.00	9.00	9.00	30.97	—
Second Grade (Below 45 per cent protein).							
Greene Chicken Feed Co., Marblehead, Mass.							
Old Fashioned, ...Greene Chicken Feed Co.	Marblehead	37.58	40.00	14.77	5.00	32.70	—
W. D. Higgins, South Framingham, Mass.							
Milford Grain Co.	Milford	40.37	30.00	8.33	12.00	40.55	—
C. G. Jordan	E. Weymouth	33.71	30.00	11.53	12.00	40.55	—
J. A. Torrey, Rockland, Mass.							
A. Culver Co.	Rockland	41.94	40.00	21.20	15.00	24.20	—

MEAT AND BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Ash.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Beach Soap Co., Lawrence, Mass.							
Bowen & Fuller	Leominster....	23.68	30.00	11.33	10.00	53.33	—
International Glue Co., Boston, Mass.							
Ground Fish, ...Marlboro Grain Co.	Marlboro	48.74	54.00	1.73	2.00	38.94	—
Lowell Rendering Co., Lowell, Mass.							
Peerless, ...F. G. Morey	Billerica	39.10	35.00	7.45	8.00	37.78	—
Ross Bros., Worcester, Mass.							
Poultry Meal, ...C. H. Laflin	Brookfield	26.62	30.00	8.40	10.00	51.44	—
Poultry Meal, ...C. H. Laflin	Brookfield	24.52	30.00	13.08	10.00	52.35	—

BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Ash Found.	Ash Guar.
Springfield Rendering Co., Springfield, Mass.							
Prentiss, Brooks & Co. ...	Easthampton..	23.96	20.00	5.72	5.00	59.95	—
Dexter Root Co.	Springfield ...	22.38	20.00	4.03	5.00	63.42	—

POULTRY MASH AND MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
Local Mixtures.							
Best of All, ...Bosworth & Son	Leominster....	20.31	20.00	5.55	4.00	3.16	—
Morning Mash, ...W. E. Bryant & Co.	Brockton	20.84	14.00	5.30	5.00	5.21	—
Morning Mash, ...W. E. Bryant & Co.	Brockton	18.61	14.00	4.87	5.00	10.25	—
Laying Feed, ...Jacob Burkhardt	Beverly.......	21.08	22.00	4.73	4.00	5.62	—
Laying Feed, ...Jacob Burkhardt	Beverly.......	23.38	22.00	5.70	4.00	7.00	—
Growing Feed,.....Jacob Burkhardt	Beverly.......	19.05	—	4.28	—	5.32	—
Perfect, ...J. B. Cover & Co.	Lowell........	17.65	15.00	4.77	2.00	7.88	—
Crescent, ...E. A. Cowee, ...	Worcester.....	16.99	12.00	4.76	4.00	3.74	—
Eureka,...........H. A. Crossman Co.	Needham	21.98	20.00	5.02	5.00	7.94	5.00
Henola, ...J. Cushing & Co.	Hudson.......	14.45	13.00	3.03	3.00	3.82	4.00
Special, ...A. Dodge Co.	Gloucester	20.88	—	5.57	—	7.74	—
F. A. Fales & Co.	Norwood	15.55	—	3.72	—	5.85	—
Fish Mash,........Greene Chicken Feed Co. .	Marblehead ..	13.52	12.00	4.98	3.00	5.50	—
Growing Feed,.....Greene Chicken Feed Co. .	Marblehead ..	12.69	12.00	3.56	3.00	4.19	—
S. B. Green & Co.	Watertown....	22.64	20.00	6.13	5.00	5.11	—
Fish Mash,........S. B. Green & Co.	Watertown....	23.29	20.00	4.63	4.00	7.43	—
Meat Mash, ...S. B. Green & Co.	Watertown....	22.56	20.00	5.83	4.00	4.45	—
Wadsworth, ...D. B. Hodgkins Sons	Gloucester	18.96	18.00	4.83	4.00	6.93	—
D. B. Hodgkins Sons	Gloucester	19.55	—	5.74	—	7.40	—
Hoosac Val. Coal & Gr. Co.	Adams	13.74	15.00	4.65	4.00	10.13	10.00
Lexington, ...Lexington Grain Co.	Lexington.....	23.91	18.00	4.66	3.00	6.53	—
Lexington, ...Lexington Grain Co.	Lexington.....	24.04	18.00	4.17	3.50	5.35	—
Maine Mash, ...William Livingston	Lowell........	16.16	10.00	4.14	3.00	9.72	—
Maine Mash, ...William Livingston	Lowell........	15.90	10.00	4.43	3.00	7.50	—
Quality, ...N. E. Poultry Supply Co. .	Springfield ...	12.78	16.00	3.57	5.00	5.25	—
Poultry Hash, ...Ropes Bros.	Salem	17.43	18.00	3.55	4.00	7.33	—
Smith Feed Co.	Westfield	21.80	—	5.62	—	10.70	—
Smith's, ...W. H. Smith	Northampton .	26.53	25.00	5.72	4.00	7.25	—
"1 H. K. Webster Co.	Lawrence	19.09	—	5.28	—	10.15	—
Very Best, ...F. F. Woodward & Co. ...	Fitchburg	14.06	11.00	2.78	3.00	7.60	—
Buffalo Cereal Co., Buffalo, N. Y.							
T. H. Emerson...........	E. Weymouth .	14.76	15.00	5.22	4.00	4.30	5.00
Griffin Bros.	Fall River	15.15	15.00	5.20	4.00	4.80	5.00
F. H. Crane & Sons	Quincy Adams	16.95	15.00	4.88	4.00	4.93	5.00

POULTRY MASH AND MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
E. A. Cowee, Worcester, Mass.							
Crescent, ...I. J. Rowell	Pepperell	22.94	20.00	5.22	4.00	5.40	—
Crescent, ...I. J. Rowell	Pepperell	23.82	20.00	5.10	4.00	5.43	—
Chas. M. Cox Co., Boston, Mass.							
Wirthmore, ...Dexter Root Co.	Springfield ...	15.64	12.00	3.18	3.00	9.58	—
Albert Dickinson Co., Chicago, Ill.							
Queen, ...J. F. Ray	Franklin	12.04	11.00	3.92	2.50	10.98	10.00
Queen, ...J. F. Ray	Franklin	12.26	11.00	2.49	2.50	7.92	10.00
R. D. Eaton Grain & Feed Co., Norwich, N. Y.							
Perfection, ...Prentiss, Brooks & Co. ...	Easthampton..	23.29	20.00	3.77	4.00	9.25	—
Greene Chicken Feed Co., Marblehead, Mass.							
Fish Mash,........F. G. Morey	Billerica	14.67	12.00	3.23	3.00	4.45	—
Green River Grain Co., Greenfield, Mass.							
A. D. Potter.	Orange	17.65	16.46	4.12	4.14	7.93	—
W. N. Potter Grain Co.	Princeton	17.21	16.46	4.91	4.14	9.13	—
Wm. S. Hills Co., Boston, Mass.							
Purity, ...C. T. Wyman............	Hubbardston .	16.42	16.00	4.83	4.30	9.54	10.00
Purity, ...Thacher & Ireland	Littleton......	13.09	—	3.85	—	5.43	—
Purity, ...I. J. Rowell	Pepperell	17.21	—	4.71	—	5.68	—
H. O. Co., Buffalo, N. Y.							
Lenox Coal & Grain Co. ...	Lenoxdale	18.26	17.00	4.52	5.50	6.58	9.00
Husted Milling Co., Buffalo, N. Y.							
Laying Mash, ...H. L. Patrick	Hopedale	16.60	15.00	5.10	3.00	4.70	8.00
Park & Pollard Co., Boston, Mass.							
Green Coal Co.	Campello	22.56	20.00	3.33	3.00	6.38	—
F. W. Dorr Co.	Newton Center	20.55	20.00	2.91	3.00	6.81	—
W. N. Potter Grain Co. ..	Princeton	15.02	20.00	2.94	3.00	3.75	—
Purina Mills, St. Louis, Mo.							
Chicken Chowder, .Knight Grain Co.	Newburyport..	17.34	16.00	4.23	2.50	8.26	9.00
Chicken Chowder, .J. Paull & Co.	Taunton	19.35	18.00	3.97	2.00	8.13	9.00
Shredded Wheat Co., Niagara Falls, N. Y.							
Shred. Wheat Waste, F. Diehl & Son	Wellesley	12.22	10.00	1.27	1.50	2.85	2.00

ALFALFA MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Clarence S. Briggs, Fowler, Colorado.							
H. L. Patrick	Hopedale	10.51	12.00	1.58	1.50	26.72	34.00
Morse Bros.	Southbridge ..	14.59	12.00	1.05	1.50	29.75	34.00
Albert Dickinson Co., Chicago, Ill.							
Greene Coal Co.	Campello	14.41	12.00	1.22	1.00	29.62	35.00
W. L. Palmer	Medway	10.51	12.00	0.98	1.00	37.88	35.00
H. Bruckman	S. Lawrence .	14.06	12.00	1.57	1.00	31.25	35.00
Kemper Mill & Elevator Co., Kansas City, Mo.							
Ropes Bros.	Salem	13.53	13.50	1.55	1.25	28.56	30.00
Purina Mills, St. Louis, Mo.							
M. G. Williams	Raynham	13.93	15.00	1.32	2.60	29.53	20.00
Purity Milling Co., Manhattan, Kansas.							
A. Carr	Northboro	12.74	—	1.65	—	31.52	—
Wichita Alfalfa Stock Food Co., Wichita, Kansas.							
W. Livingston	Lowell........	15.06	14.30	1.67	2.20	30.69	26.00

DISCUSSION OF THE INSPECTION.

1. Protein Feeds.

Cottonseed Meal
Pages 12-14

Cottonseed meal is the ground residue obtained in the extraction of oil from the cottonseed kernel. Its protein content and feeding value are affected by the amount of hulls incorporated in the meal. Cottonseed meal is much more uniform and nearer to its guarantee than formerly; few samples are found that exceed their protein guarantee by more than one or two percent. Whether this is due to the fact the manufacturers standardize their product by the addition of hulls in the case of meal running much over 41 percent in protein or to some other reason, we have been unable to ascertain.

Several samples of cottonseed feed (a mixture of unground hulls and meal) were collected. The hulls contained in the Creamo brand are sometimes known as cottonseed hull bran. The lint has been entirely removed from these hulls to be used as paper stock and in other ways. Cottonseed feed containing approximately 24 percent protein, does not have much over one-half of the value of standard cottonseed meal.

When fed in connection with bulky concentrates such as wheat bran, cottonseed meal of good quality is usually the cheapest source of protein.

Average Analyses and Retail Prices.

	High Grades (Choice).	Medium Grades (Prime and Good).	High and Medium Grades.
	1910.	1910.	1910.
No. Samples	23	25	48
Protein (per cent),	42.35	39.14	41.51
Fat (per cent),	7.96	8.07	8.02
Price a ton,	$37.43	$38.21	$37.32
	1911.	1911.	1911.
No. Samples,	15	15	30
Protein (per cent),	42.37	39.69	41.03
Fat (per cent),	8.38	8.07	8.23
Fiber (per cent),	6.86	8.54	7.70
Price a ton,	$34.36	$33.84	$34.06

	1912.	1912.	1912.
No. Samples,	42	22	64
Protein (per cent),	42.06	39.10	41.04
Fat (per cent),	7.83	7.57	7.74
Fiber (per cent),	7.86	9.36	8.38
Price a ton,	$34.70	$33.85	$34.40

Linseed Meal
Pages 14-15

The price of linseed meal has been so high during the past season that it is entitled to no consideration as an economical feeding stuff. With but one exception the product has been of good quality and free from adulteration. Most of the samples collected bearing the name of the Guy G. Major Company contained a sufficient amount of screenings to be considered adulterated.

Average Analyses and Retail Prices.

New Process.

	1909.	1910.	1911.	1912.
No. Samples,	5	5	2	5
Protein (per cent),	37.35	37.96	39.95	37.10
Fat (per cent),	3.37	2.50	2.70	2.31
Fiber (per cent),	—	—	7.20	8.29
Price a Ton,	$36.00	$37.80	$39.00	$41.60

Old Process.

	1909.	1910.	1911.	1912.
No. Samples,	11	17	8	18
Protein (per cent),	35.89	35.96	37.11	35.61
Fat (per cent),	6.22	6.10	5.76	6.72
Fiber (per cent),	—	—	7.15	7.45
Price a ton,	$36.81	$40.65	$40.50	$43.29

Gluten Meal
Page 15

Gluten meal consists of the hard, flinty part of the corn kernel which is separated from the rest of the kernel in the manufacture of corn starch. This article has again been placed upon the market after a lapse of several years. It contained fully as much protein as choice cottonseed and is about 10 percent more digestible. It retailed for about $38 a ton.

Gluten Feed.
Pages 15-16

Gluten feed is the residual matter obtained in the manufacture of starch from corn. The Cedar Rapids, Jenks and Bay State brands contained less protein than the average, due not to adulteration but to the fact thay they contained more starchy matter. While they are excellent feeds they cannot be considered as economical sources of protein for the dairy ration as the other brands.

Average Analyses and Retail Prices.

	1910. First Grade.	1910. Second Grade.	1911. All Samples.	1912. All Samples.
No. Samples,	33	6	11	30
Protein (per cent),	25.22	20.91	25.77	25.64
Fat (per cent),	3.17	6.00	3.35	2.57
Fiber (per cent),	5.92	7.53	6.42	6.63
Price a ton,	$31.88	$33.33	$28.88	$32.86

Distillers' Dried Grains.
Page 16

Distillers dried grains are the dried residue obtained from cereals in the manufacture of alcohol and distilled liquors. Owing to their bulky nature they may be used to replace bran in the ration, one pound of corn distillers' grains being equivalent to about 1 1-2 pounds of bran in feeding value. The grains derived from corn are the most valuable while those derived from rye have the least feeding value. Twenty-two samples of corn grains, 2 samples of rye grains, and 2 samples of Dearborn grains whose composition would indicate that they were derived from a mixture of corn and rye were collected. All were of good quality and, aside from a slight variation from guarantee in some cases, were as represented. The brand put out by the Continental Cereal Company is known as Continental Gluten Feed. The product is misnamed inasmuch as it is distillers' grains and not what is commonly known in the market as gluten feed*.

*For further nformation in regard to distillers' grains, see Part II. of the Twenty-third Annual Report of the Massachusetts Agricultural Experiment Station, page 72.

Average Analyses and Retail Prices.

Corn Grains.

	1909.	1910.	1911.	1912.
No. Samples,	18	14	7	22
Protein (per cent),	30.54	29.67	30.17	30.82
Fat (per cent),	11.69	11.16	11.84	11.64
Fiber (per cent),	—	12.24	11.16	10.64
Price a ton,	$34.00	$33.73	$32.66	$34.68

Rye Grains.

	1911.	1912.
No. Samples,	5	2
Protein (per cent),	16.44	15.66
Fat (per cent),	6.35	6.14
Fiber (per cent),	13.62	13.60
Price a ton,	$22.33	$24.00

Brewery By-products. **Page 17**

Malt sprouts consist of the dried sprouts removed after the process of malting barley. They sometimes contain dirt and barley hulls. Malt sprouts when fed alone are rather unpalatable but, owing to the price at which they are frequently sold, can be considered a satisfactory and economical component of the dairy ration. Most of the samples collected maintained their protein guarantee but showed a tendency to fall below in fat content.*

Only three samples of brewers' grains were collected. They were of good quality and maintained their guarantees.*

Average Analyses and Retail Prices.

Malt Sprouts.

	1909.	1910.	1911.	1912.
No. Samples,	13	8	5	17
Protein (per cent),	26.88	26.72	26.14	25.94
Fat (per cent),	1.08	1.01	1.01	1.45
Fiber (per cent),	—	12.58	12.98	11.19
Price a ton,	$27.67	$27.81	$26.50	$26.31

*For further information relative to these products, see the article "Distillery and Brewery By-products, "Twenty-third Annual Report of the Massachusetts Agricultural Experiment Station.

Brewers' Grains.

	1909.	1910.	1911.	1912.
No. Samples,	5	2	1	3
Protein (per cent),	26.86	30.35	25.54	26.52
Fat (per cent),	7.09	6.81	6.77	5.87
Fiber (per cent),	—	12.95	15.35	13.85
Price a ton,	$29.75	$30.00	$27.00	$28.33

Wheat By-products.**

Wheat middlings, wheat mixed feed, wheat bran. No attempt has been made to distinguish between the different grades of middlings. Owing to different milling processes and the difference in the resulting by-products, any attempt to classify the different grades is unsatisfactory. While Red Dog flour is readily distinguished, there seems to be no sharp line of demarkation between flour and standard middlings. Middlings which contain considerable flour will be more digestible than those made up largely of finely ground bran.

All of the wheat by-products collected were of good quality, and with few exceptions maintained their guarantees.

Average Analyses and Retail Prices.

Wheat Middlings.

	1909.	1910.	1911.	1912.
No. Samples,	63	70	37	38
Protein (per cent),	17.36	17.88	—	17.74
Fat (per cent),	5.16	5.18	—	5.04
Fiber,	—	—	—	5.83
Price a ton,	$31.16	$31.59	$30.62	$33.66

Wheat Mixed Feed.

	1909.	1910.	1911.	1912.
No. Samples,	124	163	76	138
Protein (per cent),	16.49	16.97	—	16.99
Fat (per cent),	4.74	4.71	—	4.59
Fiber,	—	—	—	7.01
Price a ton,	$30.17	$29.93	$29.51	$32.19

**The publication of the analyses of these articles has been omitted owing to the cost of this bulletin. A summary of the results is given in the text.

Wheat Bran.

	1909.	1910.	1911.	1912.
No. Samples,	38	63	23	28
Protein (per cent),	15.92	16.50	—	16.47
Fat (per cent),	4.57	4.86	—	4.28
Fiber (per cent),	—	—	—	8.73
Price a ton,	$28.65	$28.68	$28.30	$31.58

Adulterated Wheat Feeds. **Pages 17-18**

These products, sold under the trade names of Sterling, Connecticut, Kennebec and Blue Grass, consist of mixtures of wheat by-products and ground corn cobs. While they are usually offered at a price somewhat lower than that obtained for straight mixed feed, their cost is usually in excess of their feeding value and their use is not recommended. So far as known they are tagged to indicate their true content although in some cases the tag is misleading. A tag written as follows would indicate that the mixture contained ground corn as well as ground corn cob:

Wheat bran
Ground corn
Cob meal.

We have not found any of these mixtures to contain more corn than accidentally adheres to the tip of the cob after shelling.* Under the new law a feeding stuff so tagged as to be misleading in regard to its true composition, will not be registered.

Dairy Feeds. **Pages 18-19**

Under the head of dairy feeds are listed proprietary feeds consisting of a mixture of several feeding stuffs and containing 15 percent or more of protein. They are usually advertised as complete dairy rations, but do not all meet such requirements. Unicorn Dairy Ration, Union Grains, Wirthmore Balanced Ration and Purity Perfect Ration were the most satisfactory of those collected. Experience has shown that in order to feed a balanced ration when the necessary amount of home-grown roughage is at hand, the grain mixture should have the following qualifications:

*These statements apply to samples reported in this bulletin. Samples collected recently show a larger percentage of corn.

1. It should be bulky, palatable and free from mould and rancidity.

2. It should contain from 20 to 25 per cent of protein.

3. It should contain not over 9 per cent of fiber.

Seven pounds of such a mixture is a fair average amount for cows weighing 800 to 900 pounds, which are yielding 10 quarts of milk daily. For every 2 quarts of milk yielded in excess of this amount, the grain ration may be increased by 1 pound.

Molasses Feeds.
Page 19

Molasses feeds are mixtures of molasses, low grade milling offal and high grade feeding stuffs. When sold at a price less than that of wheat bran, many of them are a satisfactory substitute in the dairy ration. The samples collected varied considerably in composition but practically all maintained their guarantees. Blue Ribbon Dairy Feed contained the highest protein content of any of the brands collected.

Calf Meals.
Page 20

All of these meals will undoubtedly serve as a partial milk substitute for calves intended for dairy purposes; it is best not to begin to use these meals until the calf is about three weeks old. A satisfactory calf meal should be finely ground and composed of clean material free from taint and any noticeable amount of fiber.

Miscellaneous Protein Feeds.
Page 20

Cracker Jack Feed is a mixture of flax seed screenings and wheat screenings.

Bibby's Oil Cake Horse Feed and *Bibby's Pig Meal* are English products sold largely in the vicinity of Boston.

Argo Corn Oil Meal is the residue left after extracting corn oil from the corn germ. It is an excellent feeding stuff but is not sold extensively in New England.

H. S. Flax Feed is simply ground flax seed screenings and consists of imperfect flax seed, weed seeds and refuse material cleaned from flax seed.

Lexington Hog Food is a mixture of several feeding stuffs together with some milling offal. It is considered satisfactory for the purpose intended.

II. Starchy (Carbohydrate) Feeds.

Corn Meal. Pages 21-22

Fifty-six samples of corn meal were collected. Those collected during the autumn and made from old corn contained much less water than did those samples collected during the winter. Following is the average analysis of the old and new corn samples:

	Fall Collection (old corn).	Winter Collection (new corn).
Water, (per cent),	13.26	19.86
Protein (per cent),	9.17	8.41
Fat (per cent),	3.91	3.26
Fiber (per cent),	1.95	1.71
Price a ton,	$31.94	$30.92

At average prices, one ton of dry matter in old corn would cost $36.80, while in new corn the cost would be $38.60. None of the samples collected were adulterated although many samples of the meal, especially those shipped into the state did not consist of the entire ground kernel but were bolted or consisted of the softer parts of the kernel separated in the manufacture of table meal or cracked corn.

Average Analyses and Retail Prices.

	1909.	1910.	1911.	1912.
No. Samples,	41	51	19	53
Protein (per cent),	8.85	8.55	8.17	8.87
Fat (per cent),	3.59	3.81	2.77	3.65
Fiber (per cent),	1.88	1.84	1.58	1.85
Price a ton,	$30.79	$29.28	$24.10	$31.44

Hominy Meal. Pages 23-24

Hominy meal, feed or chop is a by-product in the manufacture of hominy grits from corn, and consists of the hull and corn germ together with a considerable portion of the corn starch. With the exception of "Star Feed" the samples collected were free from adulteration and of good quality. Star Feed is a mixture of hominy feed and ground corn cobs. While it is tagged to indicate its true composition it is sometimes sold in the place of straight hominy. *Consumers are advised to read the guarantee tag and to refuse to purchase hominy which is not guaranteed.*

Hominy meal can be used in place of corn meal in the ration and at the same price gives more food value to the ton especially when new corn is on the market which contains an excessive amount of water.

Average Analyses and Retail Prices.

	1909.	1910.	1911.	1912.
No. Samples,	51	62	21	50
Protein (per cent),	11.21	10.29	10.55	10.78
Fat (per cent),	8.61	7.94	7.79	7.54
Fiber (per cent),	—	4.21	3.87	3.68
Price a ton,	$31.72	$30.13	$26.62	$33.15

Provender.
Pages 24-25

Provender as understood locally is a mixture of straight corn and oats ground together. Occasionally provenders are offered under distinctive brands which contain oat hulls or hominy feed. The samples grouped under the term *provender* are believed to consist of pure corn and oats ground together.

Stock and Horse Feeds (less than 12 per cent protein).
Pages 25-27

Feeds of this description are proprietary mixtures consisting largely of oat by-products, corn or hominy meals, and occasionally other material. As a class they cannot be considered economical for milk production but can sometimes be used as a satisfactory oat substitute for horses when oats are high, provided they do not contain more fiber than oats. As many of them contain low grade milling offal, they should be considered only when offered at a price considerably below that asked for corn meal, hominy meal and other high grade feeding stuffs.

Stock and Horse Feeds (over 12-15 per cent protein).
Page 27

These feeding stuffs are much like those grouped under the preceding heading except that they contain more high grade material. If the price is not too high, they can be used in place of oats.

Dried Beet Pulp.
Page 27

Dried beet pulp is the dried sugar beet residue obtained in the manufacture of beet sugar. The amount offered for sale appears to be on the increase. Beet pulp should be moistened before feeding and can be considered a satisfactory though not economical substitute for silage, roots or other succulent home-grown feeds.*

When fed moistened, breeders of pure bred stock are finding it an excellent substitute for beets in feeding cows on forced tests.

Molasses Feeds.
(less than 15 per cent protein).
Page 28

Sucrene Horse Feed, of which one sample was collected, maintained its guarantee and was as represented.

Molassine Feeding Meal consisted of molasses and an unidentified absorbent, probably peat. It contained nearly 25 per cent of water. Its use is of doubtful economy.

Husted Alfalfa Horse Feed was guaranteed to contain alfalfa, corn, barley, oil meal, molasses and oat clippings. It contained about 16 per cent of water.

Germaline is a mixture of corn meal and molasses. Its keeping qualities would be improved if it did not carry such a high water content.

Alfal-Fat-Sugar Meal, *Arab Horse Feed* and *June Pasture Dairy Meal*, manufactured by the M. C. Peters Mill Company, averaged over 18 per cent in water content. Alfalfa meal and molasses were the principal ingredients.

Quaker Dairy Molasses Feed ran below its protein guarantee about 2 per cent and also exceeded its maximum fiber guarantee.

Miscellaneous Starchy Feeds.
Page 28

Dried Grains, guaranteed by A. H. Brown & Bros. of Boston, are said to be the residue from the manufacture of Mellen's Food.

Oat Feed. The 4 samples collected were of the average quality. On account of their high fiber content and price they cannot be considered economical feeding stuffs.

*See special article on "Dried Beet Residue", by Dr. Lindsey in Part II of 22d Annual Report of this station, pp. 21-26.

Cracked corn siftings, of which one sample was collected, showed about the same feeding value as corn meal.

The several grades of *corn bran* and *corn middlings* put out by the Glen Mills Cereal Company at the price asked, $22 a ton for the bran and $25 a ton for the middlings, could be considered economical sources of carbohydrates.

Maz-All-Corn Feed is a corn by-product approximating corn meal in feeding value.

Damaged Corn Meal, of which 2 samples were collected, was not only sour and tainted but contained an appreciable amount of mill refuse. It could be considered as fit only for hog feeding, if offered at reduced prices.

III. Poultry Feeds.

Animal By-products. **Pages 29-30**

Meat Scraps. A good grade of scraps should be free from taint, should be ground moderately coarse, and should not contain an excess of ash or fat. Meat scraps are sometimes made from diseased animals. While disease germs harbored in meat of this character are probably killed by thorough cooking, it is felt that meat scraps should be so tagged as to indicate their source. As scraps are purchased and fed largely on account of their meat or protein content, other things being equal, the preference should be given to those brands containing the highest percentage of protein.

Meat and Bone Meals. The brands put out by the Beach Soap Company and Ross Bros. did not maintain their protein guarantees. The ground fish put out by the International Glue Company also fell below. Ground fish residue is being quite extensively used as a poultry feed. Provided it does not taint the meat or the egg, and is free from salt, there is no reason why it should not be as valuable as meat scraps.

Poultry Mash and Meal. **Pages 30-31**

The number of prepared poultry mashes put on the market is increasing yearly, due probably to the fact that there is no branch of the grain business which offers so wide a margin of profit. It is economy for the poultry-man to study the needs of his fowls and to purchase and mix the ingredients himself. The brands collected varied widely in composition.

Alfalfa Meals. **Page 31**

The alfalfa meals collected varied widely in composition. It has been claimed that there is enough difference in the freight rate between baled and ground alfalfa in car lots to enable the western alfalfa shipper to put ground alfalfa into the eastern market as cheaply as the baled article. There is, however, in the purchase of baled alfalfa, the advantage of being able to tell something about the character of the article. It is believed that inferior and late cut alfalfa is often ground and sold as alfalfa meal.

SOME LOW GRADE PRODUCTS USED IN STOCK FEEDS.

The following products are used to a greater or less extent in some of the prepared stock feeds found in the Massachusetts markets; they are also occasionally found as adulterants of high grade feeding stuffs:

Cottonseed Hulls. Cottonseed hulls consist of the hull or hard outer coating of the cotton seed together with adhering lint left after the removal of the kernel preparatory to the extraction of the cottonseed oil. They find their way into the northern market as a component of cottonseed feed and frequently in ground form as an adulterant of high grade cottonseed meal. Cottonseed meal of good quality contains a small proportion of hulls, it not being practical to separate all of the hulls from the seed kernels before the oil is extracted. In general, however, the proportion of hulls has a considerable bearing on the protein content of the meal.

Cottonseed hulls have long been known as a favorable feed in the South where they are used as roughage. The few attempts made to introduce them into the New England markets have not, however, met with success. Some years ago a feeding experiment with milch cows was attempted with the hulls at the experiment station and it was only with difficulty that the animals could be induced to eat them. When mixed with more or less cottonseed meal their palatability is increased.

The average of five analyses made at this station was as follows:

(Pounds in 100).

	Total.		Digestible.	
	Cottonseed hulls.	Timothy hay for comparison.	Cottonseed hulls.	Timothy hay for comparison.
Water,	11.0	14.0	—	—
Ash,	2.6	4.1	—	—
Protein,	5.3	8.0	0.3	3.8
Fiber,	39.7	28.3	15.9	14.2
Nitrogen-free extract,	39.0	43.7	16.0	27.1
Fat.	2.4	1.9	2.1	1.0

Experiments have shown about 41 per cent of the cottonseed hulls to be digested and utilized by ruminants as compared with 55 per cent in case of timothy hay. In other words, in one ton of material there would be 820 pounds of cottonseed hulls or 1100 pounds of timothy hay digestible and of food value.

The preceding table shows cottonseed hulls to contain more indigestible fiber and less of the digestible nitrogen-free extract and total digestible nutrients than does timothy hay. While they should be utilized in the South, they are not worth the consideration of the northern feeder either as a product by themselves or as an admixture in good cottonseed meal.

Cottonseed hull bran differs from cottonseed hulls in the removal of the lint which is used for commercial purposes. The remarks made in connection with cottonseed hulls apply as well to the cottonseed hull bran. A single analysis made at this station showed it to consist of:

(Pounds in 100).

Water,	11.0
Ash,	1.9
Protein,	2.3
Fiber,	35.0
Nitrogen-free extract,	48.7
Fat,	1.1

Oat feed is the residue resulting from the manufacture of cereal breakfast foods. Its composition is affected by the relative amounts of hulls and middlings, the larger the amount of middlings

the higher its feeding value. Oat feed is used extensively in stock and molasses feeds. Its sale in Massachusetts as a product by itself is limited. Officials having charge of the enforcement of the feed stuff laws of some states will not recognize the term "oat feed" but require manufacturers to register and guarantee feeding stuffs in which it is used as containing oat hulls and oat middlings.

Analyses and digestion experiments made at the Massachusetts experiment station show it to have the following average analysis and digestibility:

(Pounds in 100).

	Total.		Digestible.	
	Oat Feed.	Whole Oats.	Oat Feed.	Whole oats.
Water,	7.0	11.0	—	—
Ash,	5.5	3.0	—	—
Protein,	7.9	12.5	5.1	10.7
Fiber,	21.8	8.5	7.0	2.6
Nitrogen-free extract,	55.0	60.4	23.1	47.7
Fat,	2.8	4.6	2.5	3.8

About 40 percent of the dry matter in the above sample of oat feed is digestible while whole oats show 70 percent. The low digestibility of oat feed is due to the tough, woody fiber of the oat hull. The addition of oat feed to a mixture lowers the digestibility and feeding value of the mixture.

Corn Cobs, in ground condition, are found as an adulterant in wheat feeds, hominy meal and stock feeds. Their average composition and digestibility are as follows:

(Pounds in 100.)

	Total.	Digestible.
Ash,	1.4	—
Protein,	2.2	0.4
Fiber,	32.2	20.9
Nitrogen-free extract,	55.8	33.5
Fat,	0.4	0.2

While corn cobs possess some nutritive value, their use in purchased feeding stuffs cannot be advised. When corn is a home-grown product it is believed that they can be used to advantage when ground together with the corn.

Grain screenings. Grain screenings consist of the light seed, weed seeds, chaff and dirt separated from grain in the process of winnowing. The composition of grain screenings depends upon the kind of seed from which they are separated and their freedom from dirt and chaff. They necessarily vary so much in composition that no general statement as to their value can be made. The writer has seen screenings being used in a molasses feed factory in the middle west which contained a large amount of straw and chaff. Such material cannot be considered much superior to straw in feeding value. Other samples received at this station were free from chaff and dirt and contained nothing but light grain and weed seed and possessed considerable feeding value.

Grain screenings are used extensively as a component of molasses feeds. Formerly one objection to their use was due to the fact that they contained many whole weed seeds which would pass through the animal without having their vitality impaired and become a source of weeds on the farm. With the improved process of manufacturing molasses feeds the screenings are finely ground and their germinating property destroyed.

Following are the analyses of several samples of screenings made at the Massachusetts station:

(Pounds in 100.)

	No. 1. Wheat Screenings.	No. 2. Wheat Screenings.	No. 3. Flax Screenings.
Water,	8.0	11.5	8.0
Ash,	4.9	3.8	6.0
Protein,	15.6	15.5	16.8
Fiber,	9.1	7.3	13.7
Nitrogen-free extract,	54.7	57.2	40.9
Fat,	7.7	4.7	14.6

Experiments made at this station have shown that a good quality of wheat screenings has a digestibility of about 68 percent, which is similar to the coefficient for wheat bran. When finely ground and free from dirt, chaff and noxious seeds, they possess considerable nutritive value. The feeder, however, is entitled to know that they are in a mixture.

Sample No. 1 as reported above, contained the following seeds: light oats, oat hulls, wheat, wheat refuse, smutted grain, yellow

foxtail, green foxtail, corn cockle, bindweed, flax, lady's-thumb, charlock, wild mustard, rape, lamb's-quarters, large smartweed, chaff of various sorts, wild sunflower, pigweed, timothy, shepherd's-purse, chess, oat grass, wild oats, rye and corn together with a few unidentified seeds. Of the above, corn cockle and charlock are said to possess toxic properties.

Flax shives, sometimes incorrectly called flax bran, consists of the refuse stalks and pods of the flax plant. It is used in some molasses and stock feeds. The analysis of two samples showed wide variation in composition.

	No. 1.	No. 2.
Water,	6.8	10.0
Ash,	12.1	5.0
Protein,	6.1	14.9
Fiber,	45.2	32.3
Nitrogen-free extract,	27.7	34.9
Fat,	2.1	2.9

A test of the last sample showed it to have a digestibility of about 45 percent as compared with 66 percent for wheat bran. It must be pronounced distinctly inferior for feeding.

All of the products mentioned in this article, with the possible exception of a good quality of screenings, cannot be considered as economical feeding stuffs. In admixtures it is necessary for the feeder to pay about as much for them as he would for corn meal, hominy feed and other feeds showing a much superior feeding value. The experiment station cannot consistently do otherwise than advise against their use. Under the new feeding stuffs law a statement of the ingredients is required on each sack of feed mixtures, and the purchaser has opportunity to know exactly what he is buying.

	Average Monthly Wholesale Ton Prices—1911-1912												Average
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	
Cottonseed Meal	$30.00	$30.44	$30.70	$30.09	$29.57	$30.72	$31.07	$32.25	$31.90	$31.88	$31.82	$32.00	$31.04
Linseed Meal (N. P. and O. P.)	—	—	39.17	38.33	39.13	40.00	39.69	39.47	38.25	37.69	36.00	36.00	38.37
Gluten Feed (sacked)	29.35	29.78	30.33	32.40	33.34	33.53	31.65	30.65	29.76	30.06	30.38	30.17	30.95
Gluten Feed (bulk)	28.48	28.96	29.35	31.56	32.19	32.29	30.33	29.27	28.81	29.00	29.13	29.10	29.87
Distillers' Dried Grains	31.25	32.00	32.75	33.63	—	34.00	34.00	34.25	33.25	31.25	32.25	32.25	32.81
Flour Middlings (Red Dog)	33.00	32.81	32.40	31.83	31.56	32.98	32.81	32.38	32.50	32.81	34.00	33.42	32.71
Standard Middlings (shorts)	30.46	29.60	29.15	28.63	29.66	31.50	30.97	31.13	30.00	28.63	29.81	29.25	29.90
Mixed Feed	28.88	29.22	29.28	29.59	30.31	31.88	31.94	31.75	30.95	28.82	29.04	28.25	29.99
Bran, Spring	26.00	26.25	26.85	27.25	28.75	30.44	30.19	30.00	28.20	24.88	25.19	23.88	27.32
Bran, Winter	26.42	26.56	27.10	27.67	29.31	30.88	30.56	30.56	29.50	26.00	25.00	24.53	27.84
Hominy Meal (sacked)	30.45	31.64	31.53	31.60	31.46	32.11	31.40	31.46	31.66	30.05	29.49	30.02	31.07
Hominy Meal (bulk)	29.47	30.46	30.31	30.31	30.35	30.95	29.99	30.19	29.96	28.65	27.92	28.52	29.76
Corn Meal	29.40	31.20	32.20	29.40	27.90	29.10	30.00	32.80	33.80	32.60	32.00	33.50	31.16
Corn, No. 2 yellow	27.68	29.14	31.08	—	26.78	27.32	28.92	32.50	32.14	31.24	30.04	32.58	29.95
Oats, No. 2 clipped white	33.12	34.38	34.56	34.38	35.62	38.68	39.00	40.62	39.68	38.20	39.06	31.24	36.55
Rye, No. 1	33.92	36.08	—	—	—	—	—	—	—	—	—	—	35.00
Feed Barley	36.25	35.34	35.84	36.46	35.84	38.12	38.34	40.62	39.60	39.60	30.20	26.25	36.04

BULLETIN No. 143. DECEMBER, 1912.

MASSACHUSETTS
AGRICULTURAL EXPERIMENT
STATION.

INSPECTION OF
COMMERCIAL FERTILIZERS

BY

H. D. HASKINS, L. S. WALKER, C. P. JONES and C. L. BEALS.

This bulletin gives a detailed report of the fertilizer inspection for 1912. It mentions the essential features of the fertilizer law, states the number of fertilizers inspected, gives trade values of fertilizer ingredients, provides a summary showing average composition of unmixed fertilizing material as well as pound cost of each element of plant food furnished. Special attention is called to commercial shortages existing in both unmixed fertilizing materials and mixed goods. Particular emphasis is laid upon the economy of purchasing only high grade fertilizers. A summary table shows the general standing of each manufacturer's brands. A discussion is made of the quality of plant food found present in the mixed goods, particularly with reference to the activity of the organic nitrogen. A summary table shows the general quality of nitrogen found in each manufacturer's product. Tables of analyses give the detailed composition of all fertilizers and lime products sold in the state. Commercial valuations of the plant food in all fertilizing materials, calculated from the table of trade values, are published; and for the lime compounds, the actual cost of 100 pounds of calcium and magnesium oxides is given in each case.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

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Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

*On leave.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, *Chemist.*

INSPECTION OF COMMERCIAL FERTILIZERS

FOR THE SEASON OF 1912.

By H. D. Haskins, *Chemist in Charge.*
Assisted by
L. S. Walker, C. P. Jones and C. L. Beals.*

Abstracts of Fertilizer Law.

The 1912 fertilizer inspection has been carried on under the new fertilizer law which became operative December 1,1911. The full text of the law was printed in last year's fertilizer bulletin, hence only its essential features are given at this time.

The law requires the proper branding of all goods, including lime products, with the name and principal address of the manufacturer, the number of pounds which each package contains and a guarantee of composition.

The latter must include a statement of nitrogen, water soluble potash, soluble, available and total phosphoric acid, and, in case of lime products, the percentage of total lime and magnesia and the combined percentage of carbonates of these two elements. In all cases where any part of the nitrogen is derived from pulverized leather, raw, roasted or steamed, or from untreated hair, wool waste, peat, garbage tankage, or from any inert material whatever, *the label shall state the materials from which the inert nitrogen is derived.* Goods offered in bulk must also be guaranteed and a statement made of the available phosphoric acid in basic slag phosphate based upon an analysis by the Wagner method.

The payment of an analysis fee of $8.00 for each ingredient, nitrogen, potash and phosphoric acid, contained in each brand of fertilizer, must be made annually on or before January 1st, and must be accompanied by a certified copy of the label which is to appear on each package. A certificate signed by the director of the experiment station is issued to parties complying with the above requirements.

Provisions are made for securing duplicate samples of all fertilizers: one of the duplicates to be held intact by the station

*Mr. Beals assisted in the work from July 1 to November 10.
Mr. W. A. Turner assisted in the work from July 1 to September 1.

for one year and to be at the disposal of the manufacturer or the person responsible for placing the article upon the market, the other sample to be analyzed by the station.

In the publication of results of analysis, the cost of equivalent amounts of nitrogen, potash and phosphoric acid in unmixed materials when bought for cash at retail shall appear in each case.

Manufacturers and Brands.

Ninety-seven manufacturers, importers and dealers, including the various branches of the trusts, have secured certificates for the sale of 509 different brands of fertilizer, agricultural chemicals, raw products and agricultural limes in the Massachusetts markets. This is seventeen more than were registered during the previous year. They may be classed as follows:

Complete fertilizers	328
Fertilizers furnishing phosphoric acid and potash	9
Ground bone, tankage and dry ground fish	55
Chemicals and organic nitrogen compounds	91
Agricultural limes	26
	509

Following will be found a list of those who have recorded fertilizers and lime for sale in Massachusetts during 1912, together with brands registered by each:

W. H. Abbott, Holyoke, Mass.

Abbott's Eagle Brand,
Abbott's Onion Fertilizer,
Abbott's Tobacco Fertilizer,
Abbott's Animal Fertilizer.

Alphano Humus Co., Whitehall Bldg., New York City.

Prepared Alphano Humus.

The American Agricultural Chemical Co., 92 State St., Boston, Mass.

Special Grass and Garden Mixture,
Tobacco Starter and Grower,
Grass and Lawn Top Dressing,
High Grade Fertilizer with 10% Potash,
Dry Ground Fish,
Fine Ground Bone,
Sulfate of Ammonia,
Nitrate of Soda,
High Grade Sulfate of Potash,
Muriate of Potash,
Grass and Oats Top Dressing,
Double Manure Salt,
Ground Tankage (7.41% Nitrogen),
Ground Tankage (4.94% Nitrogen),
Plain Superphosphate,
Dissolved Bone Black,
Genuine German Kainit,
Thomas Phosphate Powder (Basic Slag),
Fine Ground Nova Scotia Plaster,
High Grade Tobacco Manure,
Complete Tobacco Manure,
High Grade Dried Blood,
Bradley's Niagara Phosphate,
Bradley's Eclipse Phosphate for All Crops,
Bradley's Columbia Fish and Potash,
Bradley's Green Mountain Special,
Bradley's High Grade Potato and Root Special,
Bradley's Corn Phosphate,
Bradley's Potato Fertilizer,
Bradley's XL Superphosphate of Lime,
Bradley's Seeding Down Manure,
Bradley's Potato Manure,
Bradley's High Grade Fertilizer with 10% Potash,

Bradley's Complete Manure for Potatoes and Vegetables,
Bradley's Complete Manure for Corn and Grain,
Bradley's Complete Manure with 10% Potash,
Bradley's Complete Manure for Top Dressing Grass and Grain,
Bradley's English Lawn Fertilizer,
Clark's Cove Bay State Fertilizer, G. G.,
Clark's Cove Potato Manure,
Clark's Cove Great Planet Manure for Potatoes, Onions, Cabbage, and Market Garden Truck,
Clark's Cove Potato Fertilizer,
Clark's Cove Bay State Fertilizer,
Cumberland Superphosphate,
Cumberland Potato Fertilizer,
East India A. A. Ammoniated Superphosphate,
Crocker's Potato, Hop and Tobacco Phosphate,
Crocker's Ammoniated Corn Phosphate,
Church's Fish and Potash,
Northwestern Empire Special Manure,
Darling's General Fertilizer,
Darling's Farm Favorite,
Darling's Potato Manure,
Darling's Potato and Root Crop Manure,
Darling's Complete 10% Manure,
Darling's Blood, Bone and Potash,
Farquhar's Vegetable and Potato Fertilizer,
Farquhar's Lawn and Garden Dressing,
Farquhar's Pure Ground Bone,
Great Eastern Northern Corn Special,
Great Eastern Vegetable, Vine and Tobacco,
Great Eastern Garden Special,
Great Eastern General Fertilizer,
Pacific High Grade General Fertilizer,
Pacific Potato Special,
Soluble Pacific Guano,
Packer's Union Gardeners' Complete Manure,
Packer's Union Animal Corn Fertilizer,
Packer's Union Potato Manure,
Quinnipiac Corn Manure,
Quinnipiac Potato Phosphate,
Quinnipiac Phosphate,
Quinnipiac Potato Manure,
Quinnipiac Market Garden Manure,
Read's Standard Superphosphate,
Read's Practical Potato Special,
Read's Farmers' Friend Superphosphate,
Read's Vegetable and Vine Fertilizer,
Read's High Grade Farmers' Friend Superphosphate,
Standard Guano for All Crops,
Standard Fertilizer,
Standard Special for Potatoes,
Standard Complete Manure,
Wheeler's Corn Fertilizer,
Wheeler's Potato Manure,
Wheeler's Havana Tobacco Grower,
Williams & Clark's Prolific Crop Producer,
Williams & Clark's Royal Bone Phosphate for all Crops,
Williams & Clark's Americus Corn Phosphate,
Williams & Clark's Americus Potato Manure,
Williams & Clark's Americus Ammoniated Bone Superphosphate,
Williams & Clark's Potato Phosphate,
Williams & Clark's Americus High Grade Special for Potatoes and Vegetables.

American Cotton Oil Co., 27 Beaver St., New York City.

Choice Cottonseed Meal,
Prime Cottonseed Meal.

Armour Fertilizer Works, 930 Equitable Bldg., Baltimore, Md.

Grain Grower,
All Soluble,
Market Garden,
Complete Potato,
Fish and Potash,
Ammoniated Bone with Potash,
High Grade Potato,
Blood, Bone and Potash,
Fruit and Root Crop Special,
Onion Special,
Special Value,
Bone Meal,
Muriate of Potash,
Nitrate of Soda,
Star Phosphate,
Sulfate of Potash.

Atlantic Fertilizer Co., Stock Exchange Bldg., Baltimore, Md.

Rawson & Hodges' Garden Fertilizer,
Rawson & Hodges' Potato Special,
Rawson & Hodges' Peerless,
Rawson & Hodges' Corn and Grain.

Beach Soap Co., Lawrence, Mass.

Beach's Market Garden Fertilizer,
Beach's Advance Fertilizer,
Beach's Reliance Fertilizer,
Beach's Top Dressing,
Beach's Seeding Down,
Beach's Lawn Dressing,
Beach's Fertilizer Bone.

Berkshire Fertilizer Co., Bridgeport, Ct.

Berkshire Long Island Special,
Berkshire Tobacco Special with Carbonate Potash,
Berkshire Complete Tobacco Fertilizer,
Berkshire Complete Fertilizer,
Berkshire Potato and Vegetable Phosphate,
Berkshire Ammoniated Bone,
Berkshire Grass Special,
Berkshire Dry Ground Fish.

Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.

Bowker's Tobacco Ash Elements,
Bowker's Gloucester Fish and Potash,
Bowker's Sure Crop Phosphate,
Bowker's Bone and Wood Ash Fertilizer,
Bowker's Potato and Vegetable Phosphate,
Bowker's Corn Phosphate,
Bowker's Farm and Garden Phosphate,
Bowker's Ammoniated Food for Flowers,
Bowker's Fish and Potash, Square Brand,
Bowker's Potato and Vegetable Fertilizer,
Bowker's Corn, Grain and Grass Fertilizer,
Bowker's High Grade Fertilizer,
Bowker's Soluble Animal Fertilizer,
Bowker's Hill and Drill Phosphate,
Bowker's Market Garden Special,
Stockbridge Special Complete Manure for Seeding Down, Permanent Dressing and Legumes,
Bowker's Onion Fertilizer,
Bowker's Lawn and Garden Dressing,
Stockbridge Special Complete Manure for Potatoes and Vegetables,
Bowker's Early Potato Manure,
Bowker's Complete Alkaline Tobacco Grower,
Stockbridge Special Complete Manure for Corn and All Grain Crops,
Stockbridge Special Complete Manure for Top Dressing and for Forcing,
Stockbridge Tobacco Manure, Potash from Sulfate,
Bowker's Highly Nitrogenized Mixture,
Bowker's Fresh Ground Bone,
Bowker's Nitrate of Soda,
Bowker's Muriate of Potash,
Bowker's Sulfate of Ammonia,
Bowker's High Grade Sulfate of Potash,
Bowker's Acid Phosphate,
Bowker's Kainit,
Bowker's Dry Ground Fish,
Bowker's Pulverized Sheep Manure,
Bowker's Fine Ground Bone Tankage,
Bowker's Pure Unleached Canada Hardwood Ashes,
Bowker's Dried Blood,
Bowker's Basic Slag Phosphate,
Bowker's Nova Scotia Land Plaster,
Bowker's Dissolved Bone,
Bowker's Flour of Bone.

Joseph Breck & Sons Corporation, 51-52 N. Market St., Boston, Mass.

Breck's Lawn and Garden Dressing,
Breck's Market Garden Manure,
Ram's Head Brand Pulverized Sheep Manure.

F. W. Brode & Co., 40 S. Front St., Memphis, Tenn.

Owl Brand Cottonseed Meal.

Buckeye Cotton Oil Co., Cincinnati, Ohio.

Buckeye Cottonseed Meal.

Buffalo Fertilizer Co., William St., Buffalo, N. Y.

Fish Guano,
Farmers' Choice,
New England Special,
Celery and Potato Special,
Vegetable and Potato,
High Grade Manure,
Buffalo Tobacco Producer,
Top Dresser,
Bone Meal,
Agricultural Lime.

Cheshire Lime Manufacturing Co., Cheshire, Mass.

Agricultural Lime,
Cheshire Hydrated Agricultural Lime.

The E. D. Chittenden Co., Bridgeport, Ct.

Chittenden's Tobacco Special,
Chittenden's Complete Tobacco and Onion Grower,
Chittenden's Potato and Grain,
Chittenden's Grass and Grain,
Chittenden's Special Formula Fish and Potash,
Chittenden's Grain and Vegetable,
Chittenden's Dry Ground Fish.

Clay & Son, Stratford, London, Eng.

Clay's Fertilizer.

The Coe-Mortimer Co., 51 Chambers St., New York City.

E. Frank Coe's Celebrated Special Potato Fertilizer,
E. Frank Coe's Columbian Corn and Potato Fertilizer,
E. Frank Coe's Complete Manure with 10% Potash,
E. Frank Coe's Excelsior Potato Fertilizer,
E. Frank Coe's Famous Prize Brand Grain and Grass Fertilizer,
E. Frank Coe's Gold Brand Excelsior Guano,
E. Frank Coe's High Grade Ammoniated Bone Superphosphate,
E. Frank Coe's New Englander Corn and Potato Fertilizer,
E. Frank Coe's Red Brand Excelsior Guano for Market Gardening,
E. Frank Coe's Special Grass Top Dressing,
Peruvian Vegetable Grower,
Peruvian Market Gardeners' Fertilizer,
Peruvian Grass Top Dressing,
Warner's Special Onion Fertilizer,
Smith's Market Garden Special,
Cowls' Special Brand No. 1 Fertilizer,
Cowls' Special Brand No. 2 Fertilizer,
E. Frank Coe's Ground Animal Tankage,
E. Frank Coe's High Grade Soluble Phosphate,
E. Frank Coe's XXV Ammoniated Bone Phosphate,
Peruvian Tobacco Fertilizer,
Nitrate of Soda,
Muriate of Potash,
Sulfate of Potash,
Basic Slag Phosphate (Thomas Phosphate Powder).

S. P. Davis, Little Rock, Ark.

Good Luck Brand Cottonseed Meal.

F. E. Conley Stone Co., Utica, N. Y.

Raw Ground Lime.

John C. Dow Co., 13-14 Chatham St., Boston, Mass.

Dow's Pure Ground Bone.

The Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.

I M P Plant Food.

The Edison Portland Cement Co., Stewartsville, N. J.

Ground Limestone.

Essex Fertilizer Co., 39 N. Market St. Boston, Mass.

Essex Grass Top Dressing,
Essex Tobacco Starter and Grower,
Essex Potato Grower with 10% Potash,
Essex XXX Fish and Potash,
Essex Market Garden and Potato Manure,
Essex Complete Manure for Potatoes, Roots and Vegetables,
Essex Complete Manure for Corn, Grain and Grass,
Essex Special Potato Phosphate,
Essex A1 Superphosphate.

Farnam Cheshire Lime Co., Farnams, Mass.

Agricultural Lime.

German Kali Works, Baltimore, Md.

Muriate of Potash,
Sulfate of Potash,
Kainit,
Manure Salt.

Herbert Harris, Lime Rock, R. I.

Slaked Lime,
Ground Limestone.

Chas. W. Hastings, Dorchester Center, Mass.

Ferti Flora.

J. P. Hawes, 88 Broad St., Boston, Mass.

Bone Meal,
Basic Slag Phosphate.

Thomas Hersom & Co., New Bedford, Mass.

Pure Bone Meal,
Meat and Bone.

Home Soap Co., Worcester, Mass.

Pure Ground Bone.

Hoosac Valley Lime & Marble Co., Adams, Mass.

Adams Agricultural Lime.

The Hubbard Fertilizer Co., Baltimore, Md.

Hubbard's 5% Royal Seal,
Hubbard's Special Potato,
Hubbard's Blood, Bone and Potash,
Hubbard's Royal Ensign,
Hubbard's Farmers' I. X. L.

Humphreys Godwin Co., Memphis, Tenn.

Dixie Brand Cottonseed Meal.

John Joynt, Lucknow, Ontario, Can.

Canada Unleached Hardwood Ashes.

Listers' Agricultural Chemical Works, Newark, N. J.

Listers' High Grade Special for Spring Crops,
Listers' Success Fertilizer,
Listers' Special Corn Fertilizer,
Listers' Special Potato Fertilizer,
Listers' Potato Manure,
Listers' Special Tobacco Fertilizer,
Listers' Grain and Grass Fertilizer,
Listers' 10% Potato Grower,
Listers' Standard Grass Fertilizer,
Listers' Complete Tobacco Manure,
Listers' Nitrate of Soda,
Listers' High Grade Sulfate of Potash.

Jas. E. McGovern, Andover, Mass.

Andover Animal Fertilizer.

The Mapes Formula and Peruvian Guano Co., 143 Liberty St., New York City.

Mapes' Potato Manure,
Mapes' Tobacco Starter Improved,
Mapes' Tobacco Manure, Wrapper Brand,
Mapes' Fruit and Vine Manure,
Mapes' Economical Potato Manure,
Mapes' Vegetable or Complete Manure for Light Soils,
Mapes' Average Soil Complete Manure,
Mapes' Cauliflower and Cabbage Manure,
Mapes' Corn Manure,
Mapes' Grass and Grain Spring Top Dressing,
Mapes' Lawn Top Dressing,
Mapes' Dissolved Bone,
Mapes' Complete Manure for General Use,
Mapes' Cereal Brand,
Mapes' Topdresser Improved Full Strength,
Mapes' Tobacco Ash Constituents,
Mapes' Complete Manure 10% Potash,
Mapes' Topdresser Improved Half Strength,
Mapes' Complete Manure, A Brand,
Mapes' Double Manure Salt.

The Geo. E. Marsh Co., Lynn, Mass.

Marsh's Pure Ground Bone,
Marsh's Ground Tankage.

W. L. Mitchell, New Haven, Ct.

Lime Kiln Ashes.

Geo. L. Monroe & Sons, Oswego, N. Y.

Pure Unleached Wood Ashes.

D. M. Moulton, Monson, Mass.

Ground Bone.

National Fertilizer Co., 92 State St., Boston, Mass.

Chittenden's Complete Root and Grain Fertilizer,
Chittenden's Fine Ground Bone,
Chittenden's Fish and Potash,
Chittenden's XXX Fish and Potash,
Chittenden's Market Garden Fertilizer,
Chittenden's Ammoniated Bone Phosphate,
Chittenden's High Grade Special Tobacco Fertilizer,
Chittenden's Potato Phosphate,
Chittenden's Complete Tobacco Fertilizer,
Chittenden's Connecticut Valley Tobacco Grower,

Chittenden's Connecticut Valley Tobacco Starter,
Chittenden's Tobacco Special with Carbonate Potash,
Chittenden's Tobacco Special with Sulfate Potash,
Chittenden's Dry Ground Fish,
Chittenden's Complete Grass Fertilizer,
Chittenden's Eureka Potato Fertilizer,
Chittenden's High Grade Top Dressing,
Plain Superphosphate, 13%,
Plain Superphosphate, 17%.

Natural Guano Co., Aurora, Ill.

Sheep's Head Brand Pulverized Sheep Manure.

New England Fertilizer Co., 40 A N. Market St., Boston, Mass.

New England High Grade Potato Fertilizer,
New England Corn and Grain Fertilizer,
New England Complete Manure,
New England Corn Phosphate,
New England Superphosphate,
New England Potato Fertilizer.

New England Lime Co., Danbury, Ct.

Adams Agricultural Lime,
Adams Fresh Burned Granulated Lime,
Connecticut Agricultural Lime.

Nitrate Agencies Co., 28 Bridge St., New York City.

Nitrate of Soda,
Muriate of Potash,
Sulfate of Potash,
Acid Phosphate,
Ground Bone,
Ground Tankage,
Ground Tankage,
Basic Slag (Thomas Phosphate Powder),
Dried Blood,
Sulfate of Ammonia.

W. C. Nothern, Little Rock, Ark.

Bee Brand Cottonseed Meal.

Olds & Whipple, Hartford, Ct.

Olds & Whipple's Complete Tobacco Fertilizer,
Olds & Whipple's Complete Onion Fertilizer,
Olds & Whipple's Dry Ground Fish,
Olds & Whipple's Complete Grass Fertilizer,
Olds & Whipple's Complete Corn and Potato,
Olds & Whipple's High Grade Potato Fertilizer,
Olds & Whipple's Fish and Potash,
Olds & Whipple's Castor Pomace,
Olds & Whipple's Double Manure Salt,
Olds & Whipple's Muriate of Potash,
Olds & Whipple's Nitrate of Soda,
Olds & Whipple's Cottonseed Meal,
Olds & Whipple's Bone Meal,
Olds & Whipple's Special Onion Fertilizer,
Olds & Whipple's Vegetable Potash and Bone Phosphate,
Olds & Whipple's Agricultural Lime,
Olds & Whipple's Acid Phosphate.

Parmenter & Polsey Fertilizer Co., 40 N. Market St., Boston, Mass.

Parmenter & Polsey Star Brand Superphosphate,
Parmenter & Polsey Aroostook Special,
Parmenter & Polsey Maine Potato Fertilizer,
Parmenter & Polsey Plymouth Rock Brand Fertilizer,
Parmenter & Polsey Special Potato Fertilizer,
Parmenter & Polsey Potato Fertilizer,
Parmenter & Polsey A. A. Brand,
Parmenter & Polsey Potato Grower with 10% Potash,
Parmenter & Polsey Grain Grower.

H. F. Pillsbury & Son, St. Johnsbury, Vt.

Marl.

R. T. Prentiss, Granby, Mass.

R. T. Prentiss' Fertilizer for Potatoes,
R. T. Prentiss' Fertilizer for Corn,
R. T. Prentiss' Fertilizer for Top Dressing.

Prentiss, Brooks & Co., Holyoke, Mass.

Agricultural Lime.

Pulverized Manure Co., 28 Exchange St., Chicago, Ill.

Wizard Brand Sheep Manure,
Wizard Brand Cattle Manure.

Red Beach Plaster Co., Red Beach, Me.

Pure Ground Nova Scotia Land Plaster.

Robinson Glue Co., Gloucester, Mass.

Dried Fish Scrap.

Rockland & Rockport Lime Co., Rockland, Me.

R-R Land Lime.

The Rogers Manufacturing Co., Rockfall, Ct.

All Round Fertilizer,
Complete Potato and Vegetable,
High Grade Corn and Onion,
Pure Knuckle Bone Flour,
Pure Fine Ground Bone,
High Grade Oats and Top Dressing,
Fish and Potash,
High Grade Tobacco and Potato,
High Grade Grass and Grain Seeding Down,
High Grade Tobacco Grower,
High Grade Tobacco,
Nitrate of Soda,
Muriate of Potash,
High Grade Sulfate of Potash,
Acid Phosphate,
Ground Fish,
Tankage,
High Grade Tobacco Grower, Vegetable and Carbonate Formula.

The Rogers & Hubbard Co., Middletown, Ct.

Hubbard's Bone Base Complete Phosphate,
Hubbard's Bone Base Potato Phosphate,
Hubbard's Bone Base New Market Garden Phosphate,
Hubbard's Bone Base Soluble Corn and General Crops,
Hubbard's Bone Base Soluble Potato Manure,
Hubbard's Bone Base Soluble Tobacco Manure,
Hubbard's Bone Base Grass and Grain Fertilizer,
Hubbard's Bone Base Oats and Top Dressing,
Hubbard's Pure Raw Knuckle Bone Flour,
Hubbard's Strictly Pure Fine Bone.

Ross Brothers Co., 88 Front St., Worcester, Mass.

Ross Bros. Co.'s Potato and Vegetable Fertilizer, High Grade,
Ross Bros. Co.'s Potato and Vegetable Fertilizer,
Ross Bros. Co.'s Corn, Grass and Grain Fertilizer,
Ross Bros. Co.'s Lawn Fertilizer,
Ross Bros. Co.'s Basic Slag Meal.

N. Roy & Son, South Attleboro, Mass.

Pure Ground Bone.

Sanderson Fertilizer & Chemical Co., New Haven, Ct.

Sanderson's Formula "A",
Sanderson's Formula "B",
Sanderson's Top Dressing for Grass and Grain,
Sanderson's Complete Tobacco Grower,
Sanderson's Potato Manure,
Sanderson's Special with 10% Potash,
Sanderson's Corn Superphosphate,
Sanderson's Atlantic Coast Bone, Fish and Potash,
Sanderson's Fine Ground Fish,
Sanderson's Nitrate of Soda,
Sanderson's Muriate of Potash,
Sanderson's High Grade Sulfate of Potash,
Sanderson's Sulfate of Potash-Magnesia,
Sanderson's Plain Superphosphate,
Sanderson's Castor Meal,
Thomas Phosphate Powder (Basic Slag).

M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.

Swift-Sure Superphosphate for General Use.
Swift-Sure Bone Meal.

W. Newton Smith, Baltimore, Md.

Dirigo Brand Cottonseed Meal.

J. E. Soper Co., Chamber of Commerce, Boston, Mass.

Pioneer Cottonseed Meal,
Soper's Prime Cottonseed Meal.

Springfield Rendering Co., Springfield, Mass.

Ground Steamed Bone,
Ground Tankage.

Thomas L. Stetson, Randolph, Mass.

Pure Ground Bone.

The Stearns Lime Co., Danbury, Ct.

Ground Limestone for Soil Improvement.

Swift's Lowell Fertilizer Co., 40 N. Market St., Boston, Mass.

Swift's Lowell Lawn Dressing,
Swift's Lowell Dissolved Bone and Potash,
Swift's Lowell Perfect Tobacco Grower,
Swift's Lowell Seeding Down Fertilizer,
Swift's Lowell Corn and Vegetable,
Swift's Lowell Cereal Fertilizer,
Swift's Lowell Empress Brand,
Swift's Lowell Bone Fertilizer,
Swift's Lowell Potato Manure,
Swift's Lowell Animal Brand,
Swift's Lowell Potato Phosphate,
Swift's Lowell Superior Fertilizer with 10% Potash,
Swift's Lowell Special Grass for Top Dressing and Lawns,
Swift's Lowell Potato Grower,
Swift's Lowell Special Potato Fertilizer,
Swift's Lowell Sterling Phosphate,
Swift's Lowell Market Garden Manure,
Swift's Lowell Ground Bone,
Nitrate of Soda,
Muriate of Potash,
Acid Phosphate,
Tankage,
High Grade Sulfate of Potash,
Dissolved Bone Black,
Dried Blood,
Sulfate of Ammonia,
Nova Scotia Land Plaster.

William Thomson & Sons, Ltd., Tweed Vineyard, Clovenfords, Scotland.

Thomson's Vine, Plant and Vegetable Manure,
Thomson's Special Chrysanthemum Manure.

20th Century Specialty Co., 26 Brattle St., Boston, Mass.

The Scientific 12 L, No. 1,
The Scientific 12 L, No. 2,
The Scientific 12 L, No. 3.

Vermont Marl Co., Brattleboro, Vt.

Shell-Marl Land-Lime,
Wood Ashes Substitute,
Fine Ground Tennessee Phosphate Rock.

Charles Warner Co., Wilmington, Del.

Limoid.

Whitingham Lime Co., Greenfield, Mass.

Green Mountain Agricultural Lime.

West Stockbridge Lime Co., West Stockbridge, Mass.

Agricultural Lime.

Whitman & Pratt Rendering Co., Lowell, Mass.

Sulfate of Potash,
Muriate of Potash,
Nitrate of Soda,
Acid Phosphate,
Dried Blood,
Fine Ground Tankage,
Corn Success,
All Crop,
Potato Manure,
Potato Plowman,
Vegetable Grower,
Potash Special,
Ground Bone.

The Wilcox Fertilizer Co., Mystic, Ct.

Corn Special,
Special Superphosphate,
Fish and Potash,
Potato Fertilizer,
High Grade Fish and Potash,
Complete Bone Superphosphate,
4-8-10 Fertilizer,
High Grade Tobacco Special,
Grass Fertilizer,
Potato, Onion and Vegetable Phosphate,
High Grade Sulfate of Potash,
Muriate of Potash,
Basic Slag Meal,
Acid Phosphate,
Pure Ground Bone,
High Grade Tankage,
Dry Ground Acidulated Fish,
Dry Ground Fish Guano,
Nitrate of Soda.

S. Winter Co., Brockton, Mass.
Pure Ground Bone.

A. H. Wood & Co., Framingham, Mass.
Wood's B. B. Fertilizer,
Wood's S. P. Fertilizer,
Wood's 777 Fertilizer.

J. M. Woodard, Greenfield, Mass.
Unground Tankage.

Worcester Rendering Co., Auburn, Mass.
Ground Tankage.

Fertilizers Collected. A strenuous effort has been made to procure a representative sample of every brand of fertilizer and lime which has been registered in Massachusetts, and with few exceptions the effort has been successful. It has been possible with larger means derived from our analysis fees to visit more towns and call upon more agents. The sampling has been done by our regular inspector, Mr. James T. Howard, assisted by Mr. R. C. Tate and Mr. G. W. Simmons. During the early part of April, arrangements were made, upon request, to sample carloads of cottonseed meal, wood ashes, fertilizers and chemicals, these earlier shipments being materials which were purchased for private use by some of the larger consumers. Although this practice has made it necessary to make a much larger number of analyses than formerly, yet it has some good features as it insures the inspection of a larger tonnage than would otherwise be possible, besides furnishing the large consumer an analysis of his particular shipment. Large shipments of many private formulas have been sampled upon request. It is believed that an analysis of an officially taken sample of these materials is of more value and fairer to all parties concerned than an analysis of a sample drawn by the consumer without the aid of proper sampling instruments. As much care is taken in sampling private formulas, cottonseed meal or even material in bulk, such as wood ashes, as in sampling the average registered complete fertilizer.

The inspectors have, during the year, sampled about 5600 tons of fertilizer of all kinds and in doing this have drawn from over 15,000 bags. The inspectors have visited 138 towns during the season, called upon 329 different agents and drawn 1180 samples representing 527 distinct brands; this is 117 more samples, representing 45 more brands, than were taken during the previous year.

Fertilizers Analyzed. Seven hundred and two analyses have been made during the year's inspection; they may be grouped as follows:

Complete Fertilizers	431
Fertilizers furnishing phosphoric acid and potash, such as ashes	16

Ground bone, tankage and fish . . .	68
Nitrogen compounds, both organic and mineral	87
Potash compounds	42
Phosphoric acid compounds . . .	33
Lime compounds	25
	702

Trade Values of Fertilizing Ingredients.

At a meeting of representatives of the experiment stations of New England, New York and New Jersey, held during the first week of March, 1912, the following table of trade values was adopted; this schedule has served as a basis of valuing the fertilizers which appear in this bulletin. The trade values represent the average cash cost per pound at retail of nitrogen, potash and phosphoric acid as furnished by chemicals and standard unmixed fertilizing material in the principal markets in New York and New England. The data which are used in obtaining these values are the average wholesale quotations of chemicals and raw materials as found in commercial publications from September 1, 1911 to March 1, 1912, plus about 20 percent.

	Cents per pound.	
Nitrogen.	1911.	1912.
In ammonia salts	16	16.5
In nitrates	16	16.5
Organic nitrogen in dry and fine ground fish, meat and blood	23	22
Organic nitrogen in fine* bone, tankage and mixed fertilizers	20	19
Organic nitrogen in coarse* bone and tankage	15	15
Organic nitrogen in cottonseed meal, castor pomace, linseed meal, etc.	21	20
Phosphoric Acid.		
Soluble in water	4.5	4.5
Soluble in neutral ammonium citrate solution (reverted phosphoric acid)**	4.	4.
In fine* ground bone and tankage	4.	4.
In coarse* bone, tankage and ashes	3.5	3.5
In cottonseed meal, castor pomace and linseed meal	4.	4.
Insoluble (in neutral ammonium citrate solution) in mixed fertilizers	2.	2.

*Fine bone and tankage are separated from coarse bone and tankage by means of a sieve having circular openings 1-50 of an inch in diameter. Valuations of bone and tankage are based upon degree of fineness as well as upon composition.

**Dissolved by a neutral solution of ammonium citrate, sp. gr. 1.09, in accordance with method adopted by the Association of Official Agricultural Chemists.

Potash.

As sulfate free from chlorides	5.	5.25
As muriate (chloride)	4.25	4.25
As carbonate	8.	8.
In cottonseed meal, castor pomace, linseed meal, etc.	5.	5.

The new fertilizer law does not require the publication of the *retail cash cost*, the so-called *commercial valuation* and the *percentage difference* between the cost and the valuation of any mixed or unmixed fertilizer. The manufacturers objected very strongly to such statements on the ground that the retail cash price, especially in case of mixed fertilizers, is likely to vary considerably depending upon the amount sold and the location of the agent; and further that the percentage difference is held by many to represent the profit to the manufacturer, which is far from being the case.

In its place the law states that in connection with the actual analysis of each fertilizer, there shall be published the retail cash cost of equivalent amounts of nitrogen, phosphoric acid and potash in unmixed materials. In the tabulation of analyses published in this bulletin, this has been done, using the above trade values as a basis for computation. A single example will suffice:

Suppose a fertilizer was found by analysis to contain 4 percent or 80 pounds of organic nitrogen, 6 percent or 120 pounds of soluble phosphoric acid and 4 percent or 80 pounds of potash.

80 pounds nitrogen at 19 cents per pound—	$15.20
120 pounds phosphoric acid at 4.5 cents per pound—	5.40
80 pounds potash at 4.25 cents per pound—	3.40
	$24.00

These figures mean that one ought to be able to purchase the above amounts of nitrogen, soluble phosphoric acid and potash at retail in the form of unmixed materials for $24.00.

If such a mixture costs $34 in the local market the difference would be $10 and the percentage difference would be $\$10 \div \$24 = 41.7$. This $10 or 41.7 percentage would represent the cost to the manufacturer of taking the unmixed materials to his factory, grinding and mixing them, putting them in new bags, selling them through local agents, bad debts, long-time

credits, and profits. Anyone so disposed can figure out the percentage difference for himself on any fertilizer he may buy.

The term "commercial shortage" applied to any fertilizer means that it does not contain as much fertilizer material on a money basis as was guaranteed. Thus, the 4 percent of organic nitrogen, 6 percent of soluble phosphoric acid and 4 percent of potash in the fertilizer just referred to has a money value of $24. Now if this fertilizer did not quite test up to its several guarantees, it might only furnish $23 worth of fertility, and the difference of $1 would be the commercial shortage.

Raw Products and Chemicals.

Ground Bone. Forty-five samples of ground bone, representing thirty-two analyses, have been collected and appear in this bulletin. Seven were found deficient in phosphoric acid and one in nitrogen. In all but one case a low phosphoric acid was more than made up by an overrun of nitrogen. Bone will vary in composition more or less depending upon the amount of nitrogenous matter adhering to it. A high nitrogen denotes the presence of rather more than the normal amount of such material, and a high phosphoric acid indicates the presence of less nitrogenous matter with a correspondingly lower nitrogen percentage. Steamed bones from which the glue has been extracted contain less nitrogen and more phosphoric acid than kettle-rendered bones. The average retail cash price for ground bone has been $32.63 and the average commercial valuation as calculated by the table of trade values has been $29.24. Only one of the brands showed a small commercial shortage. Ground bone has averaged 3.12 percent nitrogen, 75.32 percent of which has been found active by the alkaline permanganate method.

Ground Tankage. Twenty-eight samples of tankage have been inspected, in some cases duplicate samples being procured in different parts of the state. Whenever this has occurred an analysis has been made of a composite sample, so that only nineteen analyses have been made. Four samples were found deficient in phosphoric acid and four in nitrogen. The average retail cash price for tankage has been $33.19, and the average commercial valuation as calculated by the tables of trade values has been $33.05 per ton. Tankage has averaged 6.58 percent total nitrogen, of which 75.38 percent has been found active by the alkaline permanganate method.

Nitrogen in fine tankage has cost on the average 19.08 cents; nitrogen in coarse tankage has cost 15.06 cents per pound. Two

samples have shown a commercial shortage of over 50 cents per ton:

Nitrate Agencies Co., No. 397. Nitrogen found 5.56%, guaranteed 6.37%; total phosphoric acid found 16.97%, guaranteed 14%.

Another sample sold by the Nitrate Agencies Co., collected in another part of the state and represented by No. 666. Nitrogen found 6.05%, guaranteed 5.35%; total phosphoric acid found 8.62%, guaranteed 16%.

Other cases of deficiencies have been made up, with one exception, by an overrun of another ingredient.

Dissolved Bone. Four analyses of dissolved bone have been made and, with the exception of one nitrogen which was slightly below, have been well up to the guarantee. The average retail cash price has been $30.25, and the average commercial valuation as calculated by the table of trade values has been $23.27 per ton. Dissolved bone has averaged 2.60 percent nitrogen, 71.16 percent of which has been found active by the alkaline permanganate method.

Dry Ground Fish. Thirteen analyses of dry ground fish have been made representing thirty-two samples. Four were found deficient in nitrogen and one in phosphoric acid. The average retail cash price per ton has been $42.16, and the average calculated commercial valuation $41.59 per ton. Nitrogen from dry ground fish has cost on the average 22.3 cents per pound. Three brands showed a commercial shortage of over 50 cents per ton. They are as follows:

Bowker Fertilizer Co., No. 405-452. Nitrogen found 8.17% guaranteed 8.23%; phosphoric acid found 5.36%, guaranteed 6%.

The E. D. Chittenden Co., No. 385. Nitrogen found 7.46%, guaranteed 8.23%; phosphoric acid found 6.66%, guaranteed 6%.

Sanderson Fertilizer and Chemical Co., No. 13-57-84-387-582-893. Nitrogen found 7.87% guaranteed 8.2%; phosphoric acid found 7.14%, guaranteed 6%.

Dry Ground Fish has averaged 8.09 percent total nitrogen, about 71 percent of which has been found active by the alkaline permanganate method.

Dried Blood. Eight samples have been examined representing six analyses; two were found deficient in nitrogen. In both cases the nitrogen deficiency was more than made up by phosphoric acid which was found present. Blood has averaged 10.46 percent total nitrogen, about 74 percent of which has been

found active by the alkaline permanganate method. The average retail cash price for blood has been $50.74 per ton, and the average calculated commercial valuation $48.26 per ton. The average pound cost of nitrogen from blood has been 23.13 cents.

Castor Pomace. Two samples have been analyzed, both of which have been found up to the guarantee. The average retail cash price has been $25.50, and the average commercial valuation calculated by the table of trade values has been $19.24 per ton. The average cost of nitrogen in this form has been 26.51 cents per pound. Castor pomace has shown on the average 4.81 percent nitrogen, about 54 percent of which has been found active by the alkaline permanganate method.

Cottonseed Meal. Fifty-six samples of cottonseed meal have been examined. Each sample represents a carload, and all of the material inspected was bought as a nitrogen source, largely for tobacco. The average retail cash price has been $31.45, and the average calculated commercial valuation $25.95 per ton. The average pound cost of nitrogen in this form has been 24.24 cents. Cottonseed meal has averaged 6.49 percent nitrogen, about 56 percent of which has been found active by the alkaline premanganate method. The following brands showed a commercial shortage of over 50 cents per ton:

S. P. Davis, No. 892. Nitrogen found 6.24%, guaranteed 6.50%.

Humphreys Godwin Co., Nos. 66, 72, 91, 93, 100, 102, 433, 434, 636, 751, 1034, 1113. Average nitrogen found 6.20%, guaranteed 6.50%.

Olds & Whipple, Nos. 187, 217, 587. Average nitrogen found 6.01%, guaranteed 6.58%.

J. E. Soper Co., Nos. 872, 1112. Average nitrogen found 6.21%, guaranteed 6.50%.

Jacksonville Oil Mill Co., No. 92. Nitrogen found 6.26%, guaranteed 6.50%.

The large number of nitrogen shortages in cottonseed meal is due probably to the practice of manufacturers in grinding a certain amount of hull and linters with the extracted meats. It might be said that it is the general practice of the shippers to allow a rebate of 50 cents per unit for protein shortages. It is believed that all of the nitrogen shortages in cottonseed meal mentioned in this bulletin have been adjusted on this basis.

Nitrate of Soda.

Thirty-nine samples have been examined representing sixteen analyses; all but one sample was found fully up to the guarantee. Nitrate of soda has cost on the average $50.70, and the average commercial valuation calculated by the table of trade values has been $51.03 per ton. The pound price of nitrogen from this source has been 16.39 cents. Only one sample showed a commercial shortage of over 50 cents per ton:

The Coe-Mortimer Co., No. 1126. Nitrogen found 14.75%, guaranteed 15%.

Sulfate of Ammonia.

Six analyses have been made representing seven samples; all have been found of good quality. The average retail cash price per ton has been $71.13, and the calculated commercial valuation $72.28 per ton. The average cost of a pound of nitrogen has been 16.23 cents.

Potash Compounds.

High Grade Sulfate of Potash.

Eighteen analyses have been made representing thirty-one samples. The potash guarantee was not maintained in five cases. The average retail cash price of this potash salt has been $50.78, and the average commercial valuation calculated from the table of trade values has been $51.47 per ton. The pound of actual potash in this form has cost on the average 5.18 cents. Two samples show a commercial shortage of over 50 cents per ton:

Bowker Fertilizer Co., Nos. 218, 407. Potash found 46.36% and 52.48%, guaranteed 48%.

Potash-Magnesia Sulfate.

Five analyses have been made representing nine samples. The potash guarantee was maintained in all cases. The average retail cash price has been $29.50, and the average commercial valuation calculated from the table of trade values has been $28.80 per ton. The pound of actual potash in this form has cost 5.38 cents.

Sample No. 965, sold by the Mapes' Formula and Peruvian Guano Co., New York City, was not a bona fide sample of potash-magnesia sulfate, but evidently high grade sulfate of potash and sulfate of magnesia reduced with sand. It contained 21.6 percent material insoluble in hot water, the greater part of which was unquestionably sand. The sample tested 8.98 percent magnesium oxide in place of the usual 13 to 14 percent. Mr. Chas. H. Mapes, secretary of the company, has this to say regarding the matter:

"What you say of the presence of 21.6 percent of insoluble matter as indicating that the material was not a bona fide sample of sulfate of potash-magnesia but possibly high grade sulfate of potash diluted with some foreign material to bring the test down, is all news to us. If done at all it must have been done at the mines in Germany before shipment. The foreign test note which they furnished us seems correct in every particular. It gives, by the way, 26.55 percent actual potash. We have taken the matter up with our factory so as to be positively certain of the identity of the particular lot from which your sample was drawn, and as soon as we hear from them will lay the information you have given us before the potash people."

The statement of the Mapes' Company is, in our opinion true. The case is probably similar to several which were detected last year, and which proved to be cases where the mines in Germany had reduced high grade sulfate of potash with sand in order to fill orders for potash-magnesia sulfate, of which there was a temporary shortage. Dr. Huston of the German Kali Works states that the practice is not tolerated by his company and heavy shipments have been returned at the expense of the mines furnishing the material, and in all cases where this practice has been detected heavy fines have also been imposed.

As has been pointed out in previous bulletins, the practice is an adulteration and the material is misbranded. Perhaps the most serious feature of the case is the low magnesia test, although of course the somewhat higher cost of the actual potash is an item of great importance. The amount of material involved in this particular case was not large, only 1½ tons being bought by one party for his own use.

Muriate of Potash.

Fifteen analyses have been made representing thirty-one samples. The potash guarantee was maintained in all but one case and in this exception the commercial shortage was less than 50 cents per ton. The average retail cash price has been $42.58, and the calculated commercial valuation $43.83 per ton. The pound of actual potash as muriate has cost on the average 4.13 cents.

In the case of some deficiencies of potash in form of muriate which occurred in last year's inspection, it was suggested by Dr. Huston that possibly the salt had absorbed moisture from the atmosphere as it is more or less deliquescent in nature. An absorption of moisture would result in a lower analysis and an apparent shortage in potash, and yet, in reality, the purchaser would get all of the potash to which he was entitled. The moisture absorption would simply cause the material to weigh more, and instead

of 2000 pounds of the salt furnishing 1000 pounds of actual potash, it might be found that the original 2000 pounds had increased six to eight pounds by absorbing that amount of moisture.

The inspectors were instructed to weigh packages in the possession of different agents to determine this point. In six cases each package weighed exactly 200 pounds; in one case each sack weighed 224 pounds, making nine sacks weigh 2016 pounds. Allowing 1¼ pounds each for the sacks, this would give a total weight of 2006 pounds from the nine sacks. As the shipment was made to fill an order for one ton of muriate, it would indicate that this sample had either absorbed moisture or else in re-bagging a liberal weight of the salt had been allowed. Assuming that it was a case of moisture absorption, it was the only case out of seven, which would show that under ordinary conditions of storage this tendency would not be great.

Kainit. Three samples have been analyzed and found well up to the guarantee.

Phosphoric Acid Compounds.

Dissolved Bone Black. Two samples of dissolved bone black have been analyzed, one of which showed a commercial shortage of over 50 cents per ton:

The American Agricultural Chemical Co., No. 362. Soluble phosphoric acid found 11.07%, guaranteed 13%; reverted phosphoric acid found 3.09%, guaranteed 2%; insoluble phosphoric acid found .28%, guaranteed 1%.

Acid Phosphate. Fourteen analyses of acid phosphate have been made representing twenty-five samples. In all but one case the guarantee of available phosphoric acid has been maintained. The average retail cash price has been $15.35 and the average commercial valuation calculated from the table of trade values has been $13.67 per ton. The pound of available phosphoric acid from acid phosphate has cost 4.77 cents.

Basic Slag Phosphate. Seventeen analyses of Thomas basic slag phosphate have been made representing twenty-three samples. Four analyses showed samples deficient in available phosphoric acid. The average retail cash price paid for basic slag was $15.19, and the average calculated commercial valuation $12.64 per ton. The pound of available phosphoric acid from basic slag, as determined by the Wagner method, has cost on the average 4.81 cents. The following brands showed a commercial shortage of over 50 cents per ton:

Bowker Fertilizer Co., No. 1. Total phosphoric acid found 15.66%, guaranteed 16%; available phosphoric acid found 6.31%, guaranteed 14%; insoluble phosphoric acid found 9.35%, guaranteed 2%. At the request of the Bowker Fertilizer Co.,another sample, No. 222, was collected of the same party, a larger number of sacks being sampled than in the previous case. This sample tested 16.31% total phosphoric acid, 8.67% available phosphoric acid and 7.64% insoluble phosphoric acid. This was a decidedly inferior article.

Ross Brothers Co., No. 734. Total phosphoric acid found 14.14%, guaranteed 18%; available phosphoric acid found 12.56%, guaranteed 13%; insoluble phosphoric acid found 1.58%, guaranteed 5%.

Mixed Complete Fertilizers.

Lessons drawn from Study of Grades of Fertilizer.

The larger number of high grade fertilizers that are being sold from year to year in Massachusetts indicates that the average farmer realizes the importance of purchasing a high grade mixture. As has been pointed out in past years, there are many advantages to be gained by choosing a formula from among the high grade goods. Summary tables have been prepared which furnish valuable data bearing upon this point.

In separating the formulas into different grades those brands containing plant food having a commercial value of $24 or over per ton have been classed as high grade, those having a value between $18 and $24 per ton medium grade, and those having a value of $18 or less per ton low grade.

Table showing average cash price and commercial plant food value per ton, also money difference between cash price and plant food value:

	High Grade		Medium Grade		Low Grade	
	1911	1912	1911	1912	1911	1912
Average Retail Cash Price per Ton	$40.87	$38.23	$35.08	$33.26	$29.64	$29.76
Average Calculated Commercial Value of Plant Food in a Ton	$28.89	$27.84	$21.04	$20.74	$15.37	$14.58
Average Money Difference	$11.98	$11.16	$14.04	$12.52	$14.27	$15.16

The above table shows:

(1). That the average ton price of the three grades of fertilizer has been $1.45 less and the average calculated commercial value of plant food in a ton 72 cents less than for the previous season.

(2). That the low grade goods were the only class which sold on the average at a slightly higher ton cost than during the previous year.

(3). That the precentage excess of the selling price over the commercial value of plant food in the low grade fertilizers is over 2½ times more than in the high grade goods and about 1¾ times more than in the medium grade fertilizers.

(4). That with a 28.5 percent advance in price over the low grade fertilizer, the high grade furnishes about 91 percent increase in commercial plant food value.

(5). The money difference between the average selling price and the average valuation in the high grade fertilizers is $4.00 less than in the low grade goods. It probably costs no more to manufacture a ton of low grade goods than it does a ton of the high grade, besides in the low grade fertilizer opportunities are offered for the use of low grade ammoniates and low grade potash compounds. These facts all emphasize the many advantages to be gained by buying only high grade mixtures.

Table showing the average composition of the three grades of fertilizer.

GRADE.	Number of Brands	Per Cent of Whole Number	Nitrogen			Phosphoric Acid			Potassium oxide	Lbs. of Available Plant Food in 100 Lbs. of Fertilizer
			Total	Percentage Availability of Total Nitrogen	Percentage Availability of Org. Nitrogen	Soluble	Reverted	Available		
High	165	48.25	3.94	85.28	68.65	3.90	3.52	7.42	7.75	19.11
Medium	105	30.88	2.59	83.40	64.46	4.46	3.25	7.71	5.08	15.38
Low	72	21.18	1.66	75.90	60.00	4.36	2.74	7.10	2.83	11.59

The above table shows:

(1). That a ton of the average high grade fertilizer furnishes 45.6 pounds more nitrogen and 98.4 pounds more actual potash than does a ton of the low grade goods.

(2). That a ton of the average high grade fertilizer furnishes 27 pounds more nitrogen and 53. 4 pounds more potash than does a ton of the medium grade goods.

(3). That with a 28.5 percent advance in price over the low grade fertilizer, the high grade furnishes about 65 percent increase in available plant food.

(4). The average high grade fertilizer with about 15 percent advance in price over the medium grade goods, furnishes over 24 percent more plant food and 34 percent increase in commercial value.

(5). The percentage activity of the total nitrogen is 9.38 percent, and the percentage activity of the organic nitrogen is 8.65 percent more in the high grade fertilizer than in the low grade brands. This would indicate the superior quality of nitrogenous materials found in the high grade brands, which is still another advantage in purchasing the latter class of fertilizer.

Table showing the comparative pound cost of nitrogen, potash and phosphoric acid in its various forms in the three grades of fertilizer.

FORM OF ELEMENT	Low Grade Fertilizer	Medium Grade Fertilizer	High Grade Fertilizer
Nitrogen (as Nitrates and Ammoniates)	33.7 cts.	26.5 cts.	22.6 cts.
Nitrogen (Organic)	38.8 "	30.5 "	26.1 "
Potash (as Muriate)	8.7 "	6.8 "	5.8 "
Soluble Phosphoric Acid	9.2 "	7.2 "	6.2 "
Reverted Phosphoric Acid	8.2 "	6.5 "	5.5 "
Insoluble Phosphoric Acid	4.1 "	3.2 "	2.7 "

This table shows:

(1). That the purchase of high grade fertilizers in place of low grade has saved nearly 12 cents on every pound of nitrogen and nearly 3 cents on every pound of potash and phosphoric acid.

(2). That the purchase of high grade fertilizers in place of medium grade has saved 4¾ cents on every pound of nitrogen and nearly 2 cents on every pound of potash and phosphoric acid.

(3). The cost of the several elements of plant food in the average high grade fertilizer amounts to $37.65 a ton. If the farmer purchases this same amount of plant food on the basis of the cost of the fertilizer elements in the low grade fertilizer, he would pay $56.17. In other words, he would pay $18.52 more for the same plant food if purchased in the form of low grade fertilizer; and he would pay $12.06 more for it if purchased in the form of medium grade fertilizer.

(4). About 52 percent of the brands of fertilizer sold in the state are classed as low and medium grade. This is by far too large a proportion as it means that those purchasing this class of goods are paying an excessive price for the actual plant food obtained, which in the aggregate must amount to many thousands of dollars.

(5). It would be much more economical to buy only high grade fertilizers and use less per acre. The brand should be selected which comes nearest fulfilling the plant food requirements in each individual case.

Summary of results of analyses of the complete fertilizers as compared with the manufacturer's guarantee.

MANUFACTURER.	No. of Brands Analyzed	No. with all three elements equal to guarantee	No. equal to guarantee in commercial value	No. with one element below guarantee	No. with two elements below guarantee	No. with three elements below guarantee.
W. H. Abbott	3	2	3	1	—	—
Alphano Humus Co.	1	1	1	—	—	—
American Agric. Chemical Co.	76	33	66	34	8	1
Armour Fertilizer Works	10	6	10	4	—	—
Beach Soap Co.	6	4	6	2	—	—
Berkshire Fertilizer Co.	15	12	15	3	—	—
Bowker Fertilizer Co.	26	19	23	6	1	—
Jos. Breck & Sons	3	1	3	2	—	—
Buffalo Fertilizer Co.	8	6	7	2	—	—
The E. D. Chittenden Co.	6	4	5	1	1	—
Clay & Son	1	1	1	—	—	—
Coe-Mortimer Co.	17	10	16	6	1	—
Eastern Chemical Co.	1	—	1	1	—	—
Essex Fertilizer Co.	9	2	6	5	2	—
C. W. Hastings	1	1	1	—	—	—
Hubbard Fertilizer Co.	5	1	5	1	3	—
Listers' Agric. Chem. Works	9	6	9	3	—	—
J. E. McGovern	1	1	1	—	—	—
Mapes' Form. & Per. Guano Co.	18	14	18	4	—	—
National Fertilizer Co.	15	6	11	9	1	—
Natural Guano Co.	1	1	1	—	—	—
New England Fertilizer Co.	7	6	7	1	—	—
Olds & Whipple	7	6	7	1	—	—
Parmenter & Polsey Fert. Co.	8	6	8	1	1	—
R. T. Prentiss	3	2	2	1	—	—
Pulverized Manure Co.	2	1	1	—	—	1
Rogers Manufacturing Co.	10	7	10	3	—	—
Rogers & Hubbard Co.	9	8	9	1	—	—
Ross Bros. Co.	4	2	3	2	—	—
Sanderson Fert. & Chem. Co.	8	5	8	3	—	—
M. L. Shoemaker & Co., Ltd.	2	2	2	—	—	—
Swift's Lowell Fertilizer Co.	16	12	16	4	—	—
20th Century Specialty Co.	3	2	3	1	—	—
Wm. Thomson & Sons	2	1	2	1	—	—
Whitman & Pratt Rendering Co.	5	5	5	—	—	—
Wilcox Fertilizer Co.	9	9	9	—	—	—
A. H. Wood & Co.	3	2	3	1	—	—

The table on the opposite page shows:

(1). That out of a total of 330 brands of complete fertilizers collected and analyzed, 124 (38 percent of the total number) fell below the manufacturer's guarantee in one or more elements.

(2). That 104 brands were deficient in one element.

(3). That 18 brands were deficient in two elements.

(4). That 2 brands were deficient in all three elements.

(5). That 26 brands (about 8 percent of the whole number analyzed) showed a commercial shortage: that is, the value of the plant food found did not equal the value of the plant food guaranteed, although overruns were used to offset shortages. The deficiencies found were divided as follows:

73 brands were found deficient in nitrogen.

31 brands were found deficient in available phosphoric acid.

42 brands were found deficient in potash.

(6). As compared with the previous year, a much better showing has been made. Fewer deficiencies have occurred, also a less number of commercial shortages. The number of nitrogen, available phosphoric acid and potash shortages were respectively 23 less, 59 less and 24 less than for the season of 1911. The brands showing a commercial shortage were two less than for the previous year.

Table showing commercial shortages (25 cents and over) in mixed commercial fertilizers for 1911 and 1912.

Commercial Shortages	Number of Brands	
	1911.	1912
Between $1.00 and $2.00 per ton	9	8
Under $1.00 not less than 25 cents per ton	17	15

A number of instances have occurred, as is frequently the case, where serious shortages of some one element have been found and yet the brands have not suffered a commercial shortage, the deficiencies being made up by overruns of some other element. Although this is not a desirable feature, perhaps it cannot always be avoided in the rush season.

Commercial Shortages.

The following brands have shown a commercial shortage of over 50 cents per ton, the value of the overruns having been used in all cases to reduce the shortages.

American Agricultural Chemical Co., Boston, Mass.—High Grade Tobacco Manure, No. 81. Nitrogen found 5.32%, guar-

anteed 5.76%; available phosphoric acid found 5.89%, guaranteed 5%; potash found 9.51%, guaranteed 10%.

Grass and Lawn Top Dressing, No. 1012. Nitrogen found 3.28%, guaranteed 3.91%; available phosphoric acid found 5.30%, guaranteed 5%; potash found 2.71%, guaranteed 2%.

Bradley's English Lawn Fertilizer, No. 507. Nitrogen found 4.50%, guaranteed 4.94%; available phosphoric acid found 4.72%, guaranteed 4%; potash found 5.39%, guaranteed 6%.

Farquhar's Vegetable and Potato Fertilizer, No. 343. Nitrogen found 2.93%, guaranteed 3%; available phosphoric acid found 6%, guaranteed 7%; potash found 6.82%, guaranteed 7%.

Read's High Grade Farmers' Friend Superphosphate, No. 833. Nitrogen found 2.76%, guaranteed 3.29%; available phosphoric acid found 6.78%, guaranteed 6%; potash found 7.76%, guaranteed 10%.

Read's Vegetable and Vine Fertilizer, No. 1005. Nitrogen found 1.97%, guaranteed 2.06%; available phosphoric acid found 8.19%, guaranteed 8%; potash found 4.48%, guaranteed 6%.

Bowker Fertilizer Co., Boston, Mass.—Stockbridge Special Complete Manure for Top Dressing and Forcing, No. 765-955. Nitrogen found 4.66%, guaranteed 4.94%; available phosphoric acid found 4.26%, guaranteed 4%; potash found 5.63%, guaranteed 6%.

The E. D. Chittenden Co., Bridgeport, Ct.—Chittenden's Potato and Grain, No. 199-635. Nitrogen found 3.10%, guaranteed 3.30%; available phosphoric acid found 7.76%, guaranteed 8%; potash found 6.08%, guaranteed 6%.

Essex Fertilizer Co., Boston, Mass.—Essex XXX Fish and Potash, No. 225-613-980. Nitrogen found 1.80%, guaranteed 2%; available phosphoric acid found 7.88%, guaranteed 8%; potash found 3%, guaranteed 3%.

National Fertilizer Co., Boston, Mass.—Chittenden's High Grade Special Tobacco Fertilizer, No. 27. Nitrogen found 5.39%, guaranteed 5.76%; available phosphoric acid found 5.97%; guaranteed 5%; potash found 9.63%, guaranteed 10%.

Chittenden's Fish and Potash, No. 249-993. Nitrogen found 2.50%, guaranteed 2.88%; available phosphoric acid found 6.76%, guaranteed 6%; potash found 3.90%, guaranteed 4%.

R. T. Prentiss, Granby, Mass.—Top Dressing, No. 1053. Nitrogen found 5.20%, guaranteed 5.70%; available phosphoric acid found 6.89%, guaranteed 6%; potash found 8.43%, guaranteed 8%.

Pulverized Manure Co., Chicago, Ill.—Wizard Brand Shredded Cattle Manure, No. 235. Nitrogen found 1.61%, guaran-

teed 1.80%; available phosphoric acid found .89%, guaranteed 1%; potash found .95%, guaranteed 1%.

Quality of Plant Food.

Character of Nitrogen Used.

There is a considerable variety of opinion among fertilizer manufacturers as to what proportion of the nitrogen in a given fertilizer formula should be present as nitrates and ammoniates (mineral forms) and as organic. Most of the formulas tested in this year's inspection have a portion of both forms present. In the low grade fertilizers 60%, and in the high and medium grades 47% of the nitrogen was present in organic forms. Another significant fact is that out of 17 analyses which showed a low activity of the water insoluble organic nitrogen (and to which special attention is called on a subsequent page) 9 or 53% were fertilizers which valued commercially less than $15 per ton; in other words, were low grade goods. Three out of the 17 were from medium grade goods and 5 or about 29% were from high grade fertilizers. The above data would indicate a tendency to use a lower grade of material in supplying the nitrogen in the cheaper grades of fertilizer and is another strong argument in favor of the purchase of high grade formulas.

It seems of interest to publish here a summary table showing the average amount, form and quality of nitrogen used by each manufacturer in the brands sold for 1912. See next page.

MANUFACTURER.	Number of Brands	Total Nitrogen	Nitrates and Ammoniates	Total Organic Nitrogen	Percentage Activity of Total Nitrogen	Percentage Activity of Total Organic Nitrogen
W. H. Abbott	3	3.57	1.25	2.32	79.50	68.60
Alphano Humus Co.	1	3.38	—	3.38	46.45	46.45
American Agric. Chemical Co.	76	2.64	1.57	1.07	86.75	67.29
Armour Fertilizer Works	10	2.43	1.19	1.24	80.25	61.30
Beach Soap Co.	6	3.91	2.61	1.30	87.22	61.54
Berkshire Fertilizer Co.	15	3.33	1.04	2.29	76.58	65.94
Bowker Fertilizer Co.	26	2.83	1.74	1.09	86.58	65.14
Jos. Breck & Sons	3	3.06	1.24	1.82	75.16	58.24
Buffalo Fertilizer Co.	8	2.69	1.52	1.17	82.16	58.98
The E. D. Chittenden Co.	6	3.60	1.86	1.74	81.12	60.92
Clay & Son	1	4.41	2.42	1.99	82.54	61.30
Coe-Mortimer Co.	17	3.13	1.81	1.32	86.26	67.43
Essex Fertilizer Co.	9	2.68	.91	1.77	80.98	71.18
Hubbard Fertilizer Co.	5	2.99	1.87	1.12	84.96	59.82
Listers' Agric. Chem. Works	9	2.56	1.37	1.19	85.94	69.75
J. E. McGovern	1	3.78	.82	2.96	74.08	66.90
Mapes' Form. & Per. Guano Co.	18	3.90	3.00	.90	90.26	57.78
National Fertilizer Co.	15	3.65	1.52	2.13	81.92	69.02
Natural Guano Co.	1	2.31	—	2.31	44.59	44.59
New England Fertilizer Co.	7	2.20	.49	1.71	83.64	78.95
Olds & Whipple	7	3.75	.79	2.96	72.54	65.20
Parmenter & Polsey Fert. Co.	8	2.79	.98	1.81	81.14	79.00
R. T. Prentiss	3	3.93	3.25	.68	94.15	66.18
Pulverized Manure Co.	2	1.93	—	1.93	42.49	42.49
Rogers Manufacturing Co.	10	3.97	1.31	2.66	81.36	72.18
Rogers & Hubbard	9	3.65	1.98	1.67	87.13	71.86
Ross Bros. Co.	3	2.66	2.02	.64	87.22	45.31
Sanderson Fert. & Chem. Co.	9	3.29	1.10	2.19	75.72	63.47
M. L. Shoemaker & Co., Ltd.	2	3.35	1.12	2.23	90.74	86.10
Swift's Lowell Fertilizer Co.	16	2.62	1.07	1.55	88.54	80.65
20th Century Specialty Co.	3	2.36	2.28	.10	98.30	40.00
Wm. Thomson & Sons	2	4.90	3.02	1.38	80.90	68.00
Whitman & Pratt Rendering Co.	5	2.96	.86	2.10	74.32	63.81
Wilcox Fertilizer Co.	9	3.31	1.04	2.27	77.04	66.52
A. H. Wood & Co.	3	4.66	3.55	1.11	90.56	60.36

In the above table it will be seen that some manufacturers' goods show a satisfactory and even high percentage activity of the total nitrogen while the percentage activity of the organic nitrogen present is relatively low. The meaning of this is that a larger proportion of the total nitrogen is present in mineral form (as nitrates and ammoniates) and to keep such a formula in good mechanical condition so as to drill readily and not cake, a certain amount of conditioner may have been used such as dry ground

peat, or garbage tankage. This practice is legitimate provided the nitrogen which the conditioner carries is not counted in the guarantee and a statement appears on the tag that such materials have been used for this purpose.

It will be seen in the complete tables of analyses that the manner of reporting the form and quality of nitrogen in the complete fertilizers varies somewhat from that of last year. It is now stated as follows:

1. Nitrogen in form of nitrates and ammoniates.
2. Water soluble organic nitrogen.
3. Active water insoluble organic nitrogen.
4. Inactive water insoluble organic nitrogen.
5. Total nitrogen found.
6. Total nitrogen guaranteed.

The following may be said in explanation of the various forms of nitrogen reported:

Nitrogen in form of Nitrates and Ammoniates. This indicates the amount of nitrogen present as nitrate of soda or potash and as sulfate of ammonia. Both are mineral forms of nitrogen, soluble in water and readily available to plants. The nitrogen from calcium cyanamid would appear in part with these forms and in part with the water soluble organic nitrogen, its availability corresponding to that in sulfate of ammonia.

Water Soluble Organic Nitrogen. This denotes that portion of the organic nitrogen which is soluble in water and which presumably is readily available to the growing plant.

Active Water Insoluble Organic Nitrogen. This includes that portion of the organic nitrogen which, although not soluble in water, is readily acted upon and liberated by the chemicals used in the modified alkaline permanganate method. This form of nitrogen is believed to be acted upon by bacteria and other forms of soil life and easily converted into forms available to the growing plant during the first year of its application. The activity of this form of nitrogen has been fairly well established by extensive vegetation experiments carried on at the Rhode Island Station and elsewhere in conjunction with a study of the alkaline permanganate method.

Inactive Water Insoluble Organic Nitrogen. As the name indicates, this includes that portion of the organic nitrogen which is not acted upon or, if acted upon, is not set free by the chemicals used in the modified alkaline permanganate method. This nitrogen will probably not be available as plant food the first season of its application, although in time it may become active.

Interpreting the Quality of the Nitrogen. In judging the quality of the organic nitrogen in a fertilizer one should be guided by the percentage activity of the total organic nitrogen as well as the percentage activity of the water insoluble organic nitrogen and *a fertilizer should not be condemned until due consideration is given for any excess of nitrogen furnished over the minimum guarantee.* For instance, out of a total of 41 brands in this year's inspection which showed an activity of the water insoluble organic nitrogen of less than 50%, 16 of them undoubtedly owed this low availability of the organic nitrogen to the presence of a small amount (200 lbs. more or less) of dry ground peat which had been used as a conditioner. The minimum nitrogen guarantee in these goods was evidently made up of nitrogen in an available form. It speaks well for the laboratory method that one is able to detect the presence of so small an amount of low grade nitrogen; since the 200 lbs. of peat would not furnish over 5 lbs. or about .25% of nitrogen.

Although no hard and fast rule can be laid down, yet fertilizers which contain a considerable quantity of organic nitrogen, only small amounts of which are water soluble and in which *less* than 50% of the water insoluble organic nitrogen is in active form, should be classed as low grade. (Cases should be viewed with suspicion where less than 50% of the water insoluble organic nitrogen is found active, even though the fertilizer may show considerable organic nitrogen in water soluble form.) It should be borne in mind that the laboratory method, although probably showing a higher activity of the nitrogen in fertilizers than is shown by vegetation experiments, does not pretend to give the true availability as shown by field or pot tests. It will and does distinguish, however, between the good and inferior forms of organic nitrogen used in commercial fertilizer mixtures.

On the basis of the above statements, there seems good reason to conclude that at least a portion of the organic nitrogen found in the following brands was derived from inferior sources:

Alphano Humus Co., New York City.
Prepared Humus.

Armour Fertilizer Works, Baltimore, Md.
Complete Potato.

Beach Soap Co., Lawrence, Mass.
Market Garden Fertilizer,
Advance Fertilizer,
Reliance Fertilizer,
Lawn Dressing.

Bowker Fertilizer Co., Boston, Mass.
Pulverized Sheep Manure,
Ammoniated Food for Flowers.

Jos. Breck & Sons, Boston, Mass.
Sheep Manure.

Buffalo Fertilizer Co., Buffalo, N. Y.
Fish Guano.

Hubbard Fertilizer Co., Baltimore, Md.
Blood, Bone and Potash,
Farmers' I. X. L.

Mapes' Formula & Peruvian Guano Co., New York City.
Economical Potato Manure,
Complete Manure for Light Soils,
Average Soil, Complete Manure,
Lawn Top Dressing,
Complete Manure for General Use,
Tobacco Ash Constituents.

Natural Guano Co., Aurora, Ill.
Pulverized Sheep Manure.

R. T. Prentiss, Granby, Mass.
Potato and Vegetable (2 samples),
Corn Fertilizer (2 samples),
Top Dressing (2 samples).

Pulverized Manure Co., Chicago, Ill.
Shredded Cattle Manure,
Pulverized Sheep Manure.

Ross Brothers Co., Worcester, Mass.
Lawn Fertilizer.

Alphano Humus Co. The company claims the nitrogen in the prepared humus has been made active by the process of manufacture; yet the indications are that the material is largely dry ground peat.

Beach Soap Co. Early in the season this company stated that it was their intention to use a small amount of dry ground peat to improve the mechanical condition of the several brands, but that the nitrogen from this source was not to be included in their guarantee. Our analyses indicate this statement to be correct. In general the statement may be made, that the use of such materials is not objectionable, provided in accordance with our fertilizer law, the nitrogen they contain is not included in the guarantee.

Bowker Fertilizer Co. The various brands of ground and shredded sheep and cattle manure have a relatively low activity as shown by all of the analyses. This is characteristic especially of the solid part of natural manures, and explains why it is so lasting (or slowly available) in the soil. There is nothing in the analyses to indicate that foreign substances have been added. In the Ammoniated Food for Flowers, which is a product put up in small packages, the presence of the relatively small amount of organic nitrogen-containing material which shows a low activity must be considered as incidental and used to improve the mechanical condition, as the total nitrogen is more than made up by the mineral forms of nitrogen.

Jos. Breck & Sons. There seems no occasion to suspect that the sheep manure put out by this company is adulterated or changed in composition from the original dried material.

Buffalo Fertilizer Co. The one brand showing a low nitrogen activity may be classed as a low grade fertilizer. The total nitrogen ran somewhat over the minimum guarantee, but the absence of water soluble organic nitrogen and the low activity of the water insoluble organic nitrogen are strong indications that some low grade material was used to furnish a portion of the nitrogen.

No explanation was received from the company when the analysis was reported.

Hubbard Fertilizer Co. The company state:

"The inactive nitrogen we would suppose comes from the garbage tankage that we use, and in no instance do we use over 200 lbs. (to the ton), and the same with each brand of goods, which is simply to make our package run of uniform size.

"This grade of tankage runs about 2.75% nitrogen and is not as soluble as the other grade that we use."

It may be said that a fair proportion of the total nitrogen was found present in form of nitrates and ammoniates, and the presence of an appreciable amount of water soluble organic nitrogen would indicate that at least a portion of the organic nitrogen was derived from the better grades of tankage. As a whole, however, the quality of the organic nitrogen was not all that could be desired.

Mapes Formula and Peruvian Guano Co. The significance of the low activity of the organic nitrogen in the six brands belonging to this company, when taken in connection with other data furnished in the analysis, would indicate the use of a small amount of garbage tankage, tartar pomace or some similar material as a conditioner. This was borne out by a statement received from the company last season, their claim being that almost all of their nitrogen was supplied from nitrates, ammonia salts, degelatinized bone meal and Peruvian guano, and that the small amount of inferior material found was used to keep the fertilizer in good mechanical condition. The brands carry a high percentage of mineral nitrogen and there seems no reason to doubt the claims of the company.

Natural Guano Co. What has already been said about the character of the nitrogen in ground sheep manure applies to the brand put out by this company. The same may be said of the two products put out by the Pulverized Manure Company.

R. T. Prentiss. The composition of these brands would indicate that a portion of the organic nitrogen was derived from garbage tankage or some similar product. There is a fair proportion of mineral nitrogen present and a considerable amount of water soluble organic nitrogen, the latter indicating that some of the organic nitrogen was derived from animal tankage.

In two of the brands the total nitrogen guarantee was maintained; the other brand showed a total nitrogen shortage of .33%. One must conclude that the quality of the organic nitrogen as a whole was not satisfactory. Mr. Prentiss states that the fertilizers were made for him by the D. B. Martin Rendering Co., Philadelphia, Pa., and that the understanding was that nothing

but high grade materials should go into the mixtures. Information has reached him from other sources that the company have been known to use considerable quantities of garbage tankage.

Ross Brothers Co. This same brand showed an unsatisfactory activity of its organic nitrogen last year. The company stated that the organic nitrogen was derived from sheep manure, tobacco dust and bone, and it is quite probable that the sheep manure and tobacco dust are responsible for the trouble. It might be added that the total nitrogen guarantee was more than made up by the mineral forms of nitrogen present.

Summary.

1. The quality of the organic nitrogen used in the fertilizers sold in Massachusetts for 1912 shows an improvement over last year. There is, however, chance for further improvement.

2. A number of brands showed an activity of water insoluble organic nitrogen slightly under 50%, but the presence of a relatively large amount of water soluble nitrogen allowed us to pass them without special mention. The standing of each one, however, is given in the tables of analysis; brands having an *inactive* water insoluble organic nitrogen greater than the active water insoluble should be viewed with suspicion.

3. From what has been said it will not be a hard task for anyone to pick out those brands where nitrogen-containing material of low availability has been used in furnishing a part of the nitrogen guarantee. These are the serious cases and it is hoped that conditions will improve another season.

Character of Phosphoric Acid.

Although the phosphoric acid guarantees are better maintained than last year, yet there seems but little difference in the relative proportions of soluble, reverted and insoluble forms in the fertilizer mixtures. Of the total phosphoric acid found in all of the brands analyzed, 83 percent was present in available form, and of the available 57 percent was in water soluble form.

There are indications that a considerable quantity of nonacidulated phosphoric-acid-containing materials enters into the composition of mixed fertilizers. As proof of this, it may be mentioned that 15 samples of acid phosphate were analyzed during the year and 96 percent of the average total phosphoric acid was classed as available. Of the available phosphoric acid, 78 percent was in water soluble form. These are considerably larger percentage solubilities than are found in the complete fertilizers. Undoubtedly considerable of the less soluble and available phos-

phoric acid in the mixed goods comes from tankage, bone and other raw products which are used in the mixtures. To what extent other nonacidulated materials were used cannot be definitely determined.

Character of Potash.

A test has been made to determine the form of potash in every sample of fertilizer analyzed. A great majority of the brands carried potash in form of muriate. In many of the guarantees of brands having potash in form of muriate, the manufacturer has given the equivalent in sulfate of potash. This practice is misleading, its object being to give the purchaser the impression that the potash is actually present as sulfate. Any doubt in this matter may be decided by reference to the tables of analyses, where potash in form of sulfate is indicated by the asterisk (*), which refers to a footnote giving the amount of potash as sulfate and muriate. Wherever the percentage of potash occurs in the tables without the asterisk or dagger following the potash percentages, the potash is in form of muriate. Only a very few cases have been noted showing the absence of chlorides in those brands where sulfate was guaranteed. The amount of chlorine present was small and has varied within relatively narrow limits, which indicates that its source was not from muriate of potash added, but rather from other chemicals and raw products used.

The presence of considerable chlorine in tobacco fertilizers is not desirable. Most of the tobacco formulas have been quite satisfactory in this respect, showing only incidental amounts of chlorine. (Thirty-eight analyses, representing 24 tobacco brands with potash guaranteed as sulfate, showed total potash 6.25%, of which 5.44% was from sulfate and .81% from muriate.) An exception to this was found in two samples of Tobacco Starter and Grower put out by the American Agricultural Chemical Company. No. 86 had a guarantee of 4% potash in form of sulfate; 4.60 % was found, of which 3.49% was from muriate and .66% from sulfate. No. 918, with the same guarantee, contained 4.52% potash as muriate and .19% potash as sulfate. Another sample of this brand, No. 660, had most of its potash as guaranteed, 4.47% being present as sulfate and only .73% as muriate. The company write that their factory superintendent is unable to account for the presence of the muriate of potash in the goods as nothing but high grade sulfate was supposed to have been used.

In some of the tobacco brands, the potash was guaranteed as carbonate and varying percentages of carbonate were actually found. Of the seventeen analyses, representing five such brands, the average potash found was 6.76%, of which 3.45% was un-

doubtedly present as claimed, enough chlorine and soluble sulfates being present to account for the remainder of the potash (.78% as muriate and 2.53% as sulfate).

Ground Rock, Mineral Fertilizer or Stone Meal.

The indications are that not much of this class of materials has been sold in the Massachusetts markets. The inspectors were not able to find it in the hands of agents, and it was probably sold by the manufacturer through soliciting agents direct to the farmer.

A sample of New Mineral Fertilizer, manufactured by the New Mineral Fertilizer Co., Boston, was taken by one of our inspectors from stock carried by the manufacturer. The analysis of this showed the presence of .09% nitrogen, .38% total phosphoric acid and .10% water soluble potash. The calculated commercial value of the material was 57 cents per ton. Extravagant claims are made by the company for the fertilizing value of the silica, chlorine, sulfur, soda, lime, magnesia, iron and alumina which the material, like all rocks and soils, contains. The ordinary soil usually contains an abundance of these elements with the possible exception of lime. Assuming the ton price to be the same as last year, ($17), a pound of nitrogen would have cost $5.67, a pound of insoluble phosphoric acid 60 cents and a pound of water soluble potash $1.27.

Dr. Charles D. Woods, Director of the Maine Agricultural Experiment Station has conducted field experiments with this material.* The results of the experiment were stated as follows by Director Woods:

"It will be noted that both with the corn and with the potatoes, there was a somewhat smaller yield on the plots to which New Mineral Fertilizer was applied than upon the plots which received no fertilizer. The comparative yields seem to clearly point out that there was no benefit from the use of the New Mineral Fertilizer."

The Massachusetts station intends to conduct some experiments with this fertilizer the coming season.

Two samples of Stonemeal manufactured by the Stonemeal Fertilizer Company of Paterson, New Jersey, who have an office in Springfield, Massachusetts, were collected and analyzed. The detailed results are listed under "Fertilizers for Private Use," immediately following the registered brands. Although this material contains a little more potash and phosphoric acid than

* See description of the experiment in the American Fertilizer, Philadelphia, Pa., Vol. XXXVII, No. 9, pp. 28-29.

did the New Mineral Fertilizer, yet it must be placed in the same class.

Lime Compounds.

Our new fertilizer law was drafted to include the inspection of lime used for agricultural purposes. This is, therefore, the first official inspection of lime which has ever been made in the state.**

Collection of Samples. The lime samples were collected by the same agents who sampled the commercial fertilizers and the same methods were followed. Forty-four samples representing 21 brands were taken from 36 different agents in 24 different towns.

Analysis of Samples. Twenty-five analyses of lime products have been made; they have been listed in the tables under two heads: 1. *Agricultural Limes* which include the slaked or hydrated limes, caustic or burnt lime and carbonates of lime (such as ground limestone, marl and lime ashes).

2. *Gypsum,* land plaster or sulfate of lime.*

The analyses as published show not only the percentage of calcium and magnesium oxides present, but the probable proportions of the various forms of these two constituents present in each sample. This enables the purchaser to select the more active forms such as caustic and hydrated (slaked) limes, or the more mild carbonate. Wherever the retail cash price of the brand has been secured, a calculation has been made showing the actual cost of 100 pounds of calcium and magnesium oxides.

Quality of Lime. Eight cases have been found where the lime guarantee has not been maintained; only one of these, however, was serious, some of the deficiencies being made up by an overrun of magnesia.

In one sample of gypsum put out by the Cement and Plaster Co., Fayetteville, N. Y., 94.33% of calcium sulfate was guaranteed and only 59.38% found. The sample however, showed the presence of 12.23% magnesium carbonate and 7.57% calcium carbonate. Even counting these materials to offset the shortage there still remains a considerable deficiency.

The tables of analyses show the lime products to vary considerably in chemical composition. The cost of 100 pounds of calcium and magnesium oxides also varies widely, ranging in the agricultural limes from 33 to 92 cents, and in the brands of gypsum from 83 cents to $1.69.

**For a discussion of the rational use of lime, ask for Bulletin No. 137.
*For use, see Bulletin 137, page 11.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
W. H. Abbott, Holyoke, Mass.				
Abbott's Eagle Brand Fertilizer	Holyoke	$31.03	362	8.03
Abbott's Onion Fertilizer	Sunderland	29.70	11	9.97
Abbott's Onion Fertilizer	Sunderland	29.23	32	10.64
Abbott's Tobacco Fertilizer	Sunderland		22	
" " "	N. Hadley	34.52	135	8.98
" " "	N. Hadley		340	
Alphano Humus Co., Whitehall Bldg., New York City.				
Prepared Humus	Manf'r's Sample	14.75	1145**	13.20
American Agric. Chem. Co., 92 State St., Boston, Mass.				
East India A. A. Ammoniated Superphosphate	New Bedford	19.41	211	11.72
Crocker's Ammoniated Corn Phosphate	Worcester	17.44	319	11.91
Crocker's Potato, Hop and Tobacco Phosphate	Princeton Depot	18.75	1105	10.87
Church's Fish and Potash, D.	New Bedford	16.12	212	10.66
" " " " "	Fall River		232	
Church's Fish and Potash, D.	Norwood	15.66	650	9.08
North Western Empire Special Manure	Fall River	24.63	291	12.76
High Grade Fertilizer with 10% Potash	New Bedford		214	
" " " " " "	W. Springfield	25.73	416	9.71
" " " " " "	Ipswich		549	
" " " " " "	Beverly		642	
High Grade Fertilizer with 10% Potash	Billerica	23.43	700	8.35
" " " " " "	Southboro		888	
Grass and Lawn Top Dressing	Boston	19.94	373	7.72
Grass and Lawn Top Dressing	Worcester	20.95	655	8.12
Grass and Lawn Top Dressing	Marlboro	17.88	1012	9.18
Complete Tobacco Manure	Hadley	29.63	1096	13.17
Tobacco Starter and Grower	Bradstreet	24.87	86	7.75
Tobacco Starter and Grower	Worcester	24.15	660	9.60
Tobacco Starter and Grower	Westfield	24.22	918	10.16
Special Grass and Garden Fertilizer	Concord	42.98	431	5.53
High Grade Tobacco Manure	Bradstreet	33.93	81	6.07
Bradley's Niagara Phosphate	W. Springfield	11.56	423	8.77
Bradley's Eclipse Phosphate for All Crops	Amesbury	14.66	505	12.27
" " " " " "	Millis		548	
Bradley's Eclipse Phosphate for All Crops	Bedford	13.04	357	11.75
Bradley's Eclipse Phosphate for All Crops	Marlboro	14.01	1011	8.67
Bradley's Columbia Fish and Potash	Westfield	14.99	921	11.91
Bradley's Green Mountain Special	Wilmington	18.33	1104	9.61
Bradley's High Grade Potato and Root Special	W. Springfield	22.54	426	11.50
Bradley's Corn Phosphate	Bradstreet	16.78	63	9.19
Bradley's Corn Phosphate	Springfield		713	
" " "	Warren	17.37	821	12.58
" " "	Bedford		853	
Bradley's Corn Phosphate	E. Longmeadow	17.42	935	10.67
Bradley's Potato Fertilizer	Amherst		44	
" " "	W. Springfield	18.32	425	12.19
" " "	Amesbury		542	
" " "	Ipswich		547	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.45	.61	1.08	.34	2.98	2.50	.80	9.07	3.55	13.42	12.00	9.87	9.00	10.04*	10.00
.93	.98	.79	.73	3.43	3.50	1.08	6.75	4.06	11.89	10.00	7.83	8.00	8.68*	7.00
1.32	.56	.89	.66	3.43	3.50	.20	8.84	2.68	11.72	10.00	9.04	8.00	8.26*	7.00
2.28	.65	.83	.64	4.40	4.00	2.59	6.63	1.76	10.98	10.00	9.22	7.00	10.22*	10.00
—	.32	1.25	1.81	3.38	1.25	—	—	—	.93	.50	-	—	1.17	.50
1.02	.58	.45	.34	2.39	2.47	5.71	3.34	3.27	12.32	10.00	9.05	9.00	2.01	2.00
1.07	.20	.53	.37	2.17	2.06	5.36	3.01	1.40	9.77	9.00	8.37	8.00	2.28	1.50
1.09	.02	.48	.41	2.00	2.06	5.45	3.12	1.07	9.64	9.00	8.57	8.00	4.53	3.00
.76	.67	.38	.32	2.13	2.06	3.95	2.57	2.52	9.04	7.00	6.52	6.00	2.08	2.00
.90	.37	.47	.33	2.07	2.06	3.55	2.70	1.91	8.16	7.00	6.25	6.00	2.49	2.00
1.92	.29	.64	.42	3.27	3.29	5.42	2.97	1.66	10.05	9.00	8.39	8.00	6.17	7.00
1.38	.99	.41	.31	3.09	2.47	4.59	1.44	2.16	8.19	7.00	6.03	6.00	10.05	10.00
1.75	.15	.47	.30	2.67	2.47	3.61	2.69	1.23	7.53	7.00	6.30	6.00	9.69	10.00
3.40	.13	.05	.04	3.62	3.91	3.89	1.93	.61	6.43	6.00	5.82	5.00	2.90	2.00
3.95	—	—	—	3.95	3.91	4.18	1.64	.18	6.00	6.00	5.82	5.00	3.26	2.00
3.10	.18	—	—	3.28	3.91	2.70	2.60	.26	5.56	6.00	5.30	5.00	2.71*	2.00
.06	1.20	1.97	1.32	4.55	4.53	.68	4.92	2.44	8.04	4.00	5.60	3.00	5.12*	5.50
1.55	.20	1.10	.40	3.25	3.29	5.55	3.23	2.52	11.30	9.00	8.78	8.00	4.60*	4.00
2.20	.22	.56	.30	3.28	3.29	4.53	3.63	1.25	9.41	9.00	8.16	8.00	5.20*	4.00
1.54	.36	.90	.62	3.42	3.29	7.08	1.59	.79	9.46	9.00	8.67	8.00	4.71*	4.00
3.85	.43	3.34	1.07	8.69	8.43	1.72	3.81	1.56	7.09	7.25	5.53	6.25	7.83	8.25
4.13	.71	.29	.19	5.32	5.76	3.04	2.85	2.22	8.11	6.00	5.89	5.00	9.51*	10.00
.22	.05	.43	.25	.95	.82	4.31	2.86	1.53	8.70	8.00	7.17	7.00	1.50	1.00
.69	.20	.31	.20	1.40	1.03	5.68	2.45	1.51	9.64	9.00	8.13	8.00	2.36	2.00
.31	.16	.33	.25	1.05	1.03	5.97	2.45	1.58	10.00	9.00	8.42	8.00	2.53	2.00
.43	.08	.48	.22	1.21	1.03	4.27	3.23	1.43	8.93	9.00	7.50	8.00	3.10	2.00
.42	.32	.67	.59	2.00	1.65	2.68	2.91	1.81	7.40	6.00	5.59	5.00	2.52	2.00
1.31	.24	.20	.19	1.94	1.65	5.23	2.19	1.10	8.52	9.00	7.42	8.00	6.14	5.00
1.21	.05	.39	.25	1.90	1.65	6.42	2.10	1.51	10.03	9.00	8.52	8.00	9.26	10.00
1.54	—	.47	.19	2.20	2.06	4.85	3.34	1.43	9.62	9.00	8.19	8.00	1.86	1.50
.83	.30	.60	.45	2.18	2.06	5.08	3.39	1.73	10.20	9.00	8.47	8.00	1.30	1.50
1.22	.12	.44	.41	2.19	2.06	5.42	2.70	1.81	9.93	9.00	8.12	8.00	2.28	1.50
1.37	.11	.41	.32	2.21	2.06	5.78	2.28	1.94	10.00	9.00	8.06	8.00	3.31	3.00

*No. 862 Chlorine .02% equivalent to .04% potash, 10.00% potash as sulfate.
" 11 " .61% " " .81% " 7.87% " " "
" 32 " .54% " " .71% " 7.55% " " "
" 22-135-340 " .45% " " .59% " 9.63% " " "
" 1012 " 1.83% " " 2.43% " .28% " " "
" 1096 " .37% " " .49% " 1.80% " " " 2.83% potash as carbonate, 5.46% total potash.
*No. 86 Chlorine .49% equivalent to .66% potash, 3.94% potash as sulfate.
" 660 " .56% " " .73% " 4.47% " " "
" 918 " 3.41% " " 4.52% " .19% " " "
" 81 " .44% " " .59% " 8.92% " " "
**3.94% Calcium oxide.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agric. Chem. Co. (Continued).				
Bradley's Potato Fertilizer	W. Brookfield	$17.96	782	12.63
" " "	Warren		836	
Bradley's Potato Fertilizer	N. Grafton	17.97	1002	11.01
" " "	N. Wilbraham		1074	
Bradley's XL Superphosphate of Lime	Amherst	19.48	18	13.10
" " " " "	Fall River		229	
" " " " "	Ipswich		559	
Bradley's XL Superphosphate of Lime	Northbridge	19.52	832	13.17
Bradley's XL Superphosphate of Lime	Westfield	20.02	920	13.46
Bradley's Seeding Down Manure	Ipswich	19.14	555	12.73
Bradley's Seeding Down Manure	Sterling	19.17	885	8.55
Bradley's Potato Manure	New Bedford	20.16	185	10.85
" " "	Fall River		231	
Bradley's Potato Manure	W. Upton	19.11	730	12.55
Bradley's Potato Manure	Southwick	18.98	903	9.50
" " "	E. Longmeadow		933	
Bradley's H. G. Fertilizer with 10% Potash	Amesbury	22.97	506	10.86
Bradley's Comp. Man. for Potatoes and Vegetables	Bradstreet	24.77	76	11.58
" " " " " " "	Marblehead		509	
Bradley's Comp. Man. for Potatoes and Vegetables	Warren	25.33	783	12.40
" " " " " " "	Holyoke		866	
Bradley's Comp. Man. for Potatoes and Vegetables	E. Longmeadow	25.09	937	10.29
Bradley's Comp. Man. for Corn and Grain	Bradstreet	25.49	79	11.25
Bradley's Comp. Man. for Corn and Grain	Fitchburg	25.30	805	11.09
" " " " " "	Holyoke		860	
Bradley's Comp. Man. for Corn and Grain	W. Boylston	25.86	998	10.73
Bradley's Comp. Man. with 10% Potash	S. Framingham	27.14	346	10.16
Bradley's Comp. Man. with 10% Potash	Monson	25.88	775	11.56
" " " " " "	W. Brookfield		785	
" " " " " "	Holyoke		861	
Bradley's Comp. Man. with 10% Potash	Westfield	27.14	910	8.34
Bradley's Comp. Man. for Top Dress. Grass & Grain	Amesbury	25 25	510	7.93
Bradley's Comp. Man. for Top Dress. Grass & Grain	Uxbridge	24.81	817	8.87
" " " " " " " " "	Bedford		858	
" " " " " " " " "	Holyoke		864	
Bradley's Comp. Man. for Top Dress. Grass & Grain	E. Longmeadow	26.20	931	6.36
Bradley's English Lawn Fertilizer	Amesbury	23.86	507	7.97
Clark's Cove Bay State Fertilizer, G. G.	Concord	17.34	487	11.38
Clark's Cove Potato Fertilizer	Concord	18.43	488	13.21
Clark's Cove Potato Fertilizer	Spencer	18.24	982	11.26
Clark's Cove Potato Manure	W. Granville	18.22	1080	10.40
Clark's Cove Great Planet Manure	E. Longmeadow	24.58	928	10.88
" " " " "	Spencer		948	
Clark's Cove Bay State Fertilizer	W. Granville	18.96	1081	12.05
Cumberland Potato Phosphate	N. Leominster	18.06	815	13.42
Cumberland Superphosphate	N. Leominster	16.75	818	13.06

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.04	.24	.43	.33	2.09	2.06	5.84	2.65	1.10	9.59	9.00	8.49	8.00	3.20	3.00
1.29	—	.46	.39	2.14	2.06	5.74	2.27	1.58	9.59	9.00	8.01	8.00	3.37	3.00
1.31	.42	.41	.36	2.50	2.47	3.48	5.96	2.12	11.56	10.00	9.44	9.00	2.22	2.00
1.25	.29	.53	.35	2.47	2.47	7.44	2.02	1.28	10.74	10.00	9.46	9.00	2.26	2.00
.69	.18	.95	.70	2.52	2.47	7.30	2.09	.89	10.28	10.00	9.39	9.00	2.58	2.00
1.19	.06	.67	.49	2.41	2.47	7.43	1.65	1.86	10.94	10.00	9.08	9.00	2.14	2.00
1.24	.30	.49	.41	2.44	2.47	5.78	3.28	1.81	10.87	10.00	9.06	9.00	2.33	2.00
1.62	.38	.33	.25	2.58	2.47	5.23	1.17	2.17	8.57	7.00	6.40	6.00	5.46	5.00
1.65	.07	.36	.33	2.41	2.47	4.12	2.41	1.33	7.86	7.00	6.53	6.00	5.41	5.00
1.38	.27	.38	.35	2.33	2.47	4.27	2.26	1.61	8.14	7.00	6.53	6.00	5.10	5.00
1.62	.13	.34	.25	2.34	2.47	4.21	2.14	1.56	7.91	7.00	6.35	6.00	10.31	10.00
2.09	.30	.42	.35	3.16	3.29	6.00	2.24	1.96	10.20	9.00	8.24	8.00	6.86	7.00
1.92	.24	.60	.45	3.21	3.29	5.83	2.53	1.51	9.87	9.00	8.36	8.00	7.32	7.00
2.63	—	.41	.23	3.27	3.29	7.68	1.38	.76	9.82	9.00	9.06	8.00	6.67	7.00
2.35	.33	.41	.26	3.40	3.29	6.06	1.85	.97	8.88	9.00	7.91	8.00	7.55	7.00
2.31	.08	.53	.32	3.29	3.29	5.65	2.36	1.07	9.08	9.00	8.01	8.00	7.71	7.00
2.43	—	.40	.26	3.09	3.29	5.58	2.30	1.28	9.16	9.00	7.88	8.00	9.36	7.00
1.61	.73	.64	.36	3.34	3.29	4.43	1.80	1.30	7.53	7.00	6.23	6.00	10.95	10.00
1.93	.14	.55	.44	3.11	3.29	4.25	2.81	1.15	8.21	7.00	7.06	6.00	9.96	10.00
1.82	.28	.73	.51	3.34	3.29	5.43	1.56	.71	7.70	7.00	6.99	6.00	10.50	10.00
4.74	.11	.06	.05	4.96	4.94	2.74	1.55	.38	4.67	6.00	4.29	4.00	5.78	6.00
4 35	.20	—	—	4.55	4.94	3.10	1.93	—	5.03	6.00	5.03	4.00	6.30	6.00
4.90	.04	—	—	4.94	4.94	3.20	1.35	1.70	6.25	6.00	4.55	4.00	6.17	6.00
4.38	—	.07	.06	4.50	4.94	3.38	1.34	.64	5.36	6.00	4.72	4.00	5.39	6.00
.88	.18	.72	.42	2.20	2.06	5.27	2.87	2.04	10.18	9.00	8.14	8.00	1.83	1.50
1.15	.27	.47	.34	2.23	2.06	4.76	3.30	1.84	9.90	9.00	8.06	8.00	3.38	3.00
1.08	.25	.44	.29	2.06	2.06	5.01	3.15	1.79	9.95	9.00	8.16	8.00	3.78	3.00
1.68	.07	.42	.30	2.47	2.47	4.34	1.73	1.28	7.35	7.00	6.07	6.00	4.57	5.00
2.19	.05	.57	.28	3.09	3.29	4.43	3.73	1.38	9.54	9.00	8.16	8.00	7.48	7.00
1.58	.18	.37	.30	2.43	2.47	7.02	1.94	1.48	10.44	10.00	8.96	9.00	2.42	2.00
1.10	.22	.44	.35	2.11	2.06	5.58	2.72	1.73	10.03	9.00	8.30	8.00	3.18	3.00
1.06	.17	.43	.38	2.04	2.06	5.65	2.70	1.45	9.80	9.00	8.35	8.00	2.00	1.50

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agric. Chem. Co. (Continued).				
Cumberland Superphosphate	N. Wilbraham	$16 45	1073	11.40
Darling's General Fertilizer	E. Pepperell	14 20	1007	7.41
Darling's Farm Favorite	Worcester	19 24	651	11.82
Darling's Potato Manure	N. Amherst	20 77	49	9.65
Darling's Potato Manure	S. Amherst	19.37	539	11.73
Darling's Potato and Root Crop Manure	N. Amherst	25.04	46	12.24
" " " " " "	Worcester		657	
Darling's Complete 10% Manure	N. Amherst	25.57	61	9.61
" " " "	Barre Plains		825	
Darling's Complete 10% Manure	S. Amherst	20.26	598	9.10
Darling's Blood, Bone and Potash	Worcester	26 87	653	9.77
" " " " "	W. Springfield		706	
" " " " "	Palmer		773	
" " " " "	E. Pepperell		1008	
Farquhar's Vegetable and Potato Fertilizer	Boston	21.62	343	10 09
Farquhar's Lawn and Garden Dressing	Boston	27.18	342	6.60
Great Eastern Northern Corn Special	Agawam	19.19	749	10.43
" " " " "	Pratt's Jct.		881	
" " " " "	Southwick		1041	
" " " " "	E. Wilbraham		1066	
Great Eastern Vegetable, Vine and Tobacco	Chelmsford	20.93	628	10.04
" " " " " "	Pratt's Jct.		879	
" " " " " "	E. Wilbraham		1062	
Great Eastern Garden Special	Pepperell	24.73	669	10.16
Great Eastern General Fertilizer	Concord	15.15	486	9.79
" " " "	Concord		679	
Pacific Potato Special	Newburyport	18.21	508	10.02
Pacific High Grade General Fertilizer	Wayland	24.47	1071	11.62
Soluble Pacific Guano	Newburyport	18.02	504	9.76
Packers' Union Gardeners' Complete Manure	Concord	25.27	681	7.88
" " " " "	Southwick		1045	
" " " " "	Glendale		1070	
Packers' Union Animal Corn Fertilizer	Glendale	19.37	1060	10.73
Packers' Union Potato Manure	Glendale	21.41	1069	11.06
Quinnipiac Corn Manure	Pittsfield	16.61	1028	9.92
Quinnipiac Potato Phosphate	Fall River	18.59	282	10.63
Quinnipiac Phosphate	Billerica	20.03	1033	10.70
Quinnipiac Potato Manure	Billerica	20.20	611	10.72
Quinnipiac Market Garden Manure	Fall River	26.39	264	10.37
" " " "	Billerica		615	
Quinnipiac Market Garden Manure	Uxbridge	24.39	839	10.12
Read's Standard Superphosphate	S. Hadley	14.06	1102	12.39
Read's Practical Potato Special	Billerica	15.03	692	6.45
Read's Farmers' Friend Superphosphate	Billerica	18.13	697	11.26
Read's Vegetable and Vine Fertilizer	S. Barre	18.50	1005	10.82
Read's Vegetable and Vine Fertilizer	Littleton	19.41	1006	11.91

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.69	.16	.61	.43	2.11	2.06	4.53	2.89	2.30	9.72	9.00	7.42	8.00	1.84	1.50
.80	.14	.24	.22	1.40	1.23	4.38	2.02	1.05	7.45	7.00	6.40	6.00	3.87	3.00
1.14	.22	.56	.39	2.31	2.06	5.27	3.05	1.20	9.52	9.00	8.32	8.00	3.97	3.00
1.39	.24	.61	.35	2.59	2.47	4.13	3.93	1.20	9.26	7.00	8.06	6.00	5.03	5.00
1.51	.17	.48	.31	2.47	2.47	3.95	2.71	1.58	8.24	7.00	6.66	6.00	5.15	5.00
2.13	.14	.58	.33	3.18	3.29	5.04	3.07	1.33	9.44	9.00	8.11	8.00	7.64	7.00
2.00	.15	.63	.39	3.17	3.29	3.74	2.87	1.40	8.01	7.00	6.61	6.00	9.75	10.00
1.68	.16	.86	.53	3.23	3.29	4.15	3.25	1.02	8.42	7.00	7.40	6.00	11.86	10.00
2.63	.15	.72	.36	3.86	4.11	4.82	2.48	1.40	8.70	8.00	7.30	7.00	7.81	7.00
2.19	.02	.45	.27	2.93	3.00	5.04	.96	1.17	7.17	—	6.00	7.00	6.82	7.00
1.97	.36	.76	.46	3.55	3.30	.19	9.97	4.92	15.08	14.00	10.16	4.00	5.37	7.00
1.24	.15	.55	.42	2.36	2.47	6.44	2.90	1.40	10.74	10.00	9.34	9.00	2.54	2.00
1.22	.30	.41	.24	2.17	2.06	5.68	2.46	1.20	9.34	9.00	8.14	8.00	6.74	6.00
2.44	.14	.45	.24	3.27	3.29	4.72	3.41	1.28	9.41	9.00	8.13	8.00	7.11	7.00
.22	.23	.32	.30	1.07	.82	4.78	3.15	1.25	9.18	9.00	7.93	8.00	4.55	4.00
1.13	.24	.45	.31	2.13	2.06	5.55	2.59	1.38	9.52	9.00	8.14	8.00	3.60	3.00
2.44	.04	.31	.25	3.04	3.29	5.29	3.03	1.45	9.77	9.00	8.32	8.00	7.50	7.00
.78	.32	.52	.46	2.08	2.06	5.61	3.73	1.43	10.77	9.00	9.34	8.00	2.25	1.50
1.42	.13	.57	.50	2.62	2.47	4.02	2.90	1.35	8.27	7.00	6.92	6.00	9.55*	10.00
1.26	.26	.53	.36	2.41	2.47	6.85	2.48	1.51	10.84	10.00	9.33	9.00	2.46	2.00
.96	.01	.51	.43	1.91	2.06	6.41	2.22	1.22	9.85	9.00	8.63	8.00	7.75	6.00
1.05	.15	.45	.34	1.99	2.06	5.49	2.70	1.35	9.54	9.00	8.19	8.00	2.27	1.50
.98	.30	.42	.42	2.12	2.06	5.42	2.97	2.17	10.56	9.00	8.39	8.00	3.41	3.00
1.29	.32	.51	.38	2.50	2.47	6.29	3.41	2.19	11.89	10.00	9.70	9.00	2.29	2.00
1.38	.33	.52	.30	2.53	2.47	4.78	3.10	1.25	9.13	7.00	7.88	6.00	4.71	5.00
1.92	.34	.77	.42	3.45	3.29	5.74	2.28	1.98	10.00	9.00	8.02	8.00	7.60	7.00
2.42	.20	.39	.30	3.31	3.29	6.06	2.29	1.22	9.57	9.00	8.35	8.00	6.76	7.00
.34	.12	.30	.27	1.03	.82	4.95	2.43	1.45	8.83	9.00	7.38	8.00	3.93	4.00
.57	.16	.22	.14	1.09	.82	2.97	1.80	.66	5.43	5.00	4.77	4.00	8.00	8.00
.94	.20	.51	.32	1.97	2.06	5.93	2.79	1.38	10.10	9.00	8.72	8.00	3.53	3.00
1.04	.15	.48	.30	1.97	2.06	5.55	2.64	1.56	9.75	9.00	8.19	8.00	4.48	6.00
1.25	.04	.23	.22	1.74	2.06	6.35	2.72	.86	9.93	9.00	9.07	8.00	6.09	6.00

*No. 681–1045–1070 Chlorine 1.84% equivalent to 2.45% potash, 7.10% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agric. Chem. Co. (Concluded).				
Read's High Grade Farmers' Friend Superphosphate	S. Barre	$22.70	833	10.62
Read's High Grade Farmers' Friend Superphosphate	Hadley	25.87	1108	12.83
Standard Guano for All Crops	Spencer	14.27	956	10.92
Standard Fertilizer	Whitman	17.86	638	10.64
" "	Conway		972	
Standard Special for Potatoes	Whitman	18.14	695	11.45
" " " "	Monson		777	
Standard Complete Manure	Monson	25.11	776	10.56
Wheeler's Corn Fertilizer	Chelmsford	16.54	616	10.43
" " "	Pepperell		736	
" " "	Southwick		1039	
Wheeler's Potato Manure	Pepperell	18.80	724	10.86
" " "	Agawam		745	
" " "	Boxboro		991	
Wheeler's Havana Tobacco Grower	Agawam	25.50	746	6.62
" " " "	Danvers		845	
" " " "	Southwick		1040	
" " " "	E. Wilbraham		1064	
Wheeler's Havana Tobacco Grower	Danvers	25.83	1147	3.40
Williams & Clark Prolific Crop Producer	Worcester	14.25	663	9.53
Williams & Clark Royal Bone Phosphate	Newburyport	14.54	501	10.71
Williams & Clark Americus Corn Phosphate	Wilkinsonville	18.33	794	9.57
" " " " "	Southboro		882	
Williams & Clark Americus Potato Manure	Wilkinsonville	18.17	787	11.21
" " " " "	Southboro		883	
Williams & Clark Am. Amm'ed Bone Superphosphate	Andover	18.46	1103	13.06
Williams & Clark Potato Phosphate	Andover	18.92	1106	9.13
Armour Fertilizer Works, Baltimore, Md.				
Grain Grower	Newburyport	15.42	535	10.37
" "	Ipswich		550	
" "	Woburn		693	
American Farmers' Market Garden Special	N. Hadley	26.43	147	8.80
Complete Potato	Newburyport	18.45	541	9.99
" "	Woburn		698	
" "	Hudson		988	
" "	Marlboro		1010	
Fish and Potash	Taunton	14.82	237	8.76
Ammoniated Bone with Potash	Salem	16.26	620	8.00
" " " "	Norwood		652	
" " " "	Woburn		687	
" " " "	Feeding Hills		902	
" " " "	Marlboro		1013	
High Grade Potato	Amherst	22.53	37	10.32
" " "	Taunton		230	
" " "	Milford		735	
" " "	Feeding Hills		901	
" " "	Hudson		994	
Blood, Bone and Potash	Amherst	23.19	45	10.66
" " " "	N. Hadley		308	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.69	.07	.66	.34	2.76	3.29	3.63	3.15	1.66	8.44	7.00	6.78	6.00	7.76	10.00
2.44	.11	.27	.25	3.07	3.29	3.63	3.39	.86	7.88	7.00	7.02	6.00	10.72	10.00
.48	.19	.32	.29	1.23	1.03	5.58	2.48	1.38	9.44	9.00	8.06	8.00	2.47	2.00
1.12	.16	.50	.47	2.25	2.06	5.88	2.34	1.76	9.98	9.00	8.22	8.00	2.37	1.50
.93	.20	.49	.40	2.02	2.06	6.06	2.14	1.68	9.88	9.00	8.20	8.00	3.65	3.00
2.50	.01	.44	.30	3.25	3.29	3.85	4.45	1.58	9.88	9.00	8.30	8.00	7.47	7.00
.78	.25	.50	.37	1.90	1.65	5.08	2.84	1.60	9.52	9.00	7.92	8.00	2.62	2.00
1.00	.27	.49	.41	2.17	2.06	5.53	2.90	1.88	10.31	9.00	8.43	8.00	3.53	3.00
1.59	.08	.63	.44	2.74	2.47	5.08	1.96	1.38	8.42	7.00	7.04	6.00	8.96*	10.00
1.79	.23	.45	.23	2.70	2.47	6.02	1.84	1.44	9.30	7.00	7.86	6.00	8.73*	10.00
.77	.03	.23	.19	1.22	0.82	5.00	2.40	1.30	8.70	8.00	7.40	7.00	3.60	1.00
.30	.17	.35	.35	1.17	1.03	6.33	1.89	1.60	9.82	9.00	8.22	8.00	2.81	2.00
1.03	.46	.59	.33	2.41	2.06	5.43	2.72	1.98	10.13	9.00	8.15	8.00	2.15	1.50
1.29	.14	.37	.30	2.10	2.06	5.61	2.51	1.98	10.10	9.00	8.12	8.00	3.51	3.00
1.61	.18	.39	.35	2.53	2.47	5.93	2.21	1.40	9.54	10.00	8.14	9.00	2.33	2.00
1.56	.37	.35	.30	2.58	2.47	4.02	2.11	1.17	7.30	7.00	6.13	6.00	4.83	5.00
.68	05	.52	.41	1.66	1.65	5.40	2.85	.68	8.93	8.50	8.25	8.00	2.41	2.00
2.65	.10	.34	.27	3.36	3.30	7.83	1.34	.40	9.57	8.50	9.17	8.00	6.38**	7.00
.82	.19	.41	.47	1.89	1.65	4.40	2.68	1.04	8.12	7.50	7.08	7.00	6.06	6.00
.42	.17	.75	.73	2.07	2.06	3.50	2.40	.76	6.66	6.50	5.90	6.00	2.10	2.00
.76	.18	.83	.60	2.37	2.47	3.55	2.45	.89	6.89	6.50	6.00	6.00	2.48	2.00
.75	.19	.45	.38	1.77	1.65	4.98	3.04	1.12	9.14	8.50	8.02	8.00	10.37	10.00
3.08	—	.63	.45	4.16	4.11	6.23	2.20	.61	9.04	8.50	8.43	8.00	7.43	7.00

*No. 746-845-1040-1064 Chlorine .82% equivalent to 1.10% potash, 7.86% potash as sulfate.
*No. 1147 Chlorine .67% equivalent to .89% potash, 7.84% potash as sulfate.
**No. 147 Potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Armour Fertilizer Works. (Concluded)				
Fruit and Root Crop Special	Newburyport	$17.92	844	9.53
Onion Special	Amherst	29.09	30	9.11
Onion Special	N. Hadley	29.67	307	9.74
All Soluble " " " "	Amherst Taunton Hadley	21.23	36 236 601	11.02
Beach Soap Company, Lawrence, Mass.				
Beach's Market Garden Fertilizer	Lawrence	33.34	563	5.56
Beach's Advance Fertilizer " " "	Lawrence Lynn	27.03	572 619	9.46
Beach's Reliance Fertilizer " " "	Lawrence Lynn	21.23	578 685	7.98
Beach's Top Dressing Fertilizer	Lawrence	40.06	564	2.87
Beach's Seeding Down Fertilizer " " " "	Lawrence Lynn	30.52	565 625	4.62
Beach's Lawn Dressing Fertilizer " " " "	Lawrence Lynn	26.13	571 623	9.47
Berkshire Fertilizer Company, Bridgeport, Ct.				
Berkshire Long Island Special	Sunderland	26.09	14	8.03
Berkshire Long Island Special " " " "	Sunderland N. Hadley	26.42	55 145	9.65
Berkshire Tobacco Special with Carbonate of Potash "	Sunderland N. Hadley N. Hadley Plainville	29.13	56 114 116 592	10.04
Berkshire Tobacco Special with Carbonate of Potash	N. Hadley	23.74	113	9.33
Berkshire Complete Tobacco Fertilizer "	Sunderland N. Hadley N. Hadley Bradstreet N. Hadley N. Hadley	24.99	9 138 158 189 310 327	9.34
Berkshire Complete Tobacco Fertilizer " " " "	Hadley N. Hadley	24.70	750 1036	7.87
Berkshire Complete Fertilizer	Bradstreet	23.74	69	11.12
Berkshire Complete Fertilizer " " " " " "	N. Hadley N. Hadley S. Deerfield	26.00	111 117 583	9.53
Berkshire Complete Fertilizer	N. Amherst	24.75	200	7.82
Berkshire Complete Fertilizer	N. Hadley	25.05	298	10.62
Berkshire Complete Fertilizer	Sunderland	24.43	419	9.95
Berkshire Potato and Vegetable Phosphate " " " " "	W. Bridgew'r Upton	16.92	567 737	7.55
Berkshire Ammoniated Bone Phosphate " " " "	N. Westport Upton	14.43	374 732	7.37
Berkshire Grass Special	Westfield	25.11	1032	6.06

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.66	.50	.24	.27	1.67	1.65	3.13	4.10	1.60	8.83	8.50	7.23	8.00	6.07	5.00
.96	.07	.79	.61	2.43	2.47	8.65	3.52	1.56	13.73	12.50	12.17	12.00	10.71	10.00
.92	.17	.87	.53	2.49	2.47	10.30	2.06	1.98	14.34	12.50	12.36	12.00	10.53	10.00
1.35	.24	.76	.53	2.88	2.88	4.60	3.41	1.07	9.08	8.50	8.01	8.00	4.37	4.00
3.72	.31	.35	.38	4.76	4.74	3.73	3.59	1.26	8.58	8.00	7.32	7.00	10.10*	9.75
1.99	.49	.44	.51	3.43	2.50	6.31	2.33	3.14	11.78	10.00	8.64	8.00	5.98*	6.00
.66	.48	.64	.89	2.67	1.65	1.30	6.74	4.26	12.30	10.00	8.04	8.00	3.71	3.00
5.25	—	.36	.34	5.95	5.35	.10	5.24	1.91	7.25	7.00	5.34	4.00	17.68	15.00
.25	.91	.71	.69	2.56	1.85	.68	4.94	8.82	14.44	14.00	5.62	5.00	15.08	14.50
3.76	.07	.11	.16	4.10	4.00	4.25	1.78	4.03	10.06	9.50	6.03	7.50	6.55	5.25
1.22	.38	1.37	.69	3.66	3.30	4.50	1.44	1.48	7.42	7.00	5.94	6.00	8.24	7.00
1.89	.03	1.25	.74	3.91	3.30	4.95	1.81	.74	7.50	7.00	6.76	6.00	7.40	7.00
.76	.93	1.38	1.63	4.75	4.50	.83	2.63	1.32	4.78	4.00	3.46	3.00	5.75*	5.50
.79	1.30	1.32	1.37	4.78	4.50	trace	3.68	1.14	4.82	4.00	3.68	3.00	5.19*	5.50
1.01	.15	.94	.74	2.84	2.50	5.80	2.62	1.58	10.00	9.00	8.42	8.00	6.55*	6.00
.71	.42	.96	.67	2.76	2.50	4.60	4.64	.40	9.64	9.00	9.24	8.00	6.36*	6.00
.45	.38	1.13	.72	2.68	2.50	5.20	3.62	.46	9.28	9.00	8.82	8.00	7.08	6.00
.78	.42	1.30	.32	3.32	2.50	2.98	6.00	1.12	10.10	9.00	8.98	8.00	6.71*	6.00
.39	.14	1.21	.77	3.01	2.50	5.93	2.41	1.89	10.23	9.00	8.34	8.00	6.73	6.00
1.09	.05	1.51	.70	3.35	2.50	5.65	1.82	1.89	9.36	9.00	7.47	8.00	6.53	6.00
.63	.40	1.40	.61	3.04	2.50	3.76	4.86	.46	9.08	9.00	8.62	8.00	6.81	6.00
.65	.17	.65	.46	1.93	1.70	3.35	3.11	.38	6.84	7.00	6.46	6.00	5.00	4.00
.12	.03	.60	.53	1.23	0.80	5.43	2.25	.64	8.32	9.00	7.63	8.00	3.20	2.00
3.56	.23	.98	.52	5.29	5.00	2.10	2.30	.46	5.36	5.00	4.90	4.00	2.92	2.00

*No. 568 Chlorine .85% equivalent to 1.13% potash, 8.97% potash as sulfate.
" 572–619 " .37% " " .48% " 5.50% " " "
" 56–114–116–592 " .31% " " .41% " 1.47% " " " 3.90% potash as carbonate, 5.99% total potash.
*No. 118 Chlorine .37% equivalent to .49% potash, .67% potash as sulfate, 4.03% potash as carbonate, 5.81% total potash.
*No. 9–138–158–189–310–327 Chlorine .47% equivalent to .62% potash, 5.93% potash as sulfate.
" 750–1036 " .47% " " .62% " 5.74% " "
" 111–117–583 " 4.52% " " 6.00% " .71% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Gloucester Fish and Potash	Taunton . .	$13.68	472	9.34
Bowker's Sure Crop Bone Phosphate	Rockland .	14.02	696	8.95
" " " " "	Leominster .		687	
Bowker's Bone and Wood Ash Fertilizer	Dighton . .	15.58	287	9.38
" " " " " "	Lowell . .		614	
" " " " " "	Springfield .		741	
Bowker's Potato and Vegetable Phosphate . . .	Dighton . .	16.34	262	9.34
" " " " " . . .	Bridgewater		569	
" " " " " . . .	Clinton . .		886	
Bowker's Corn Phosphate	Dighton . .	16.32	260	11.68
" " "	Chelmsford .		631	
" " "	Littleton .		1014	
Bowker's Farm and Garden Phosphate	Bridgewater	16.28	537	10.88
" " " " "	Walpole . .		680	
" " " " "	Springfield .		739	
" " " " "	Hudson . .		937	
" " " " "	Littleton .		1009	
" " " " "	Adams . .		1022	
Bowker's Fish and Potash, Square Brand . . .	Dighton . .	18.26	258	11.17
" " " " " "	Northampton		451	
" " " " " "	Easthampton		1051	
Bowker's Potato and Vegetable Fertilizer . . .	Dighton . .	20.92	259	13.49
" " " " "	Brockton .		399	
" " " " "	Northampton		436	
Bowker's Potato and Vegetable Fertilizer . . .	Norwood . .	20.07	846	11.54
Bowker's Corn, Grain and Grass Fertilizer . . .	Millis . .	20.24	529	12.07
" " " " " " "	Springfield .		742	
" " " " " " "	Southbridge		959	
" " " " " " "	W. Boylston.		1003	
Bowker's High Grade Fertilizer	Beverly . .	21.41	645	11.20
" " " "	Lowell . .		646	
" " " "	Leominster .		876	
Bowker's Soluble Animal Fertilizer	Dighton . . .	21.24	273	12.25
Bowker's Soluble Animal Fertilizer	Fall River . .	20.12	236	11.79
Bowker's Hill and Drill Phosphate	Northampton	19.70	448	10.06
" " " " "	Concord . .		493	
" " " " "	Leominster .		780	
" " " " "	Plymouth .		348	
" " " " "	W. Boylston		992	
Bowker's Market Garden Fertilizer	Brockton .	23.75	402	10.91
" " " "	Taunton .		469	
" " " "	Concord . .		492	
" " " "	Marblehead .		502	
Bowker's Market Garden Fertilizer	Springfield . .	23.39	766	9.86
Stockbridge Spec. Comp. Man. for Seed. Down, Perm. Dress. and Legumes	Dighton . .	25.43	294	8.03
Stockbridge Spec. Comp. Man. for Seed. Down, Perm. Dress. and Legumes	Bridgewater		523	
Stockbridge Spec. Comp. Man. for Seed. Down, Perm. Dress. and Legumes	Northampton .	23.23	456	9.34

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.75	.05	.28	.22	1.30	0.82	5.42	3.11	1.04	9.57	9.00	8.53	8.00	1.55	1.00
.22	.19	.42	.36	1.19	0.82	4.13	4.06	1.68	9.87	9.00	8.19	8.00	2.31	2.00
.90	.17	.49	.34	1.90	1.65	4.08	2.71	1.56	8.37	7.00	6.79	6.00	2.76	2.00
.82	.20	.44	.35	1.81	1.65	5.65	3.20	1.35	10.20	9.00	8.85	8.00	2.57	2.00
.87	.14	.47	.29	1.77	1.65	5.23	3.35	1.42	10.00	9.00	8.58	8.00	2.43	2.00
.79	.13	.42	.36	1.70	1.65	5.55	2.82	1.56	9.93	9.00	8.37	8.00	2.74	2.00
1.14	.31	.65	.56	2.66	2.47	1.98	3.08	1.73	6.79	5.00	5.06	4.00	4.46	4.00
1.58	.24	.44	.41	2.68	2.47	6.38	1.64	1.73	9.75	9.00	8.02	8.00	4.46	4.00
1.35	.18	.44	.36	2.33	2.47	4.88	3.28	1.84	10.00	9.00	8.16	8.00	4.87	4.00
1.59	.19	.40	.29	2.47	2.47	5.80	2.68	1.32	9.80	9.00	8.48	8.00	4.42	4.00
1.44	.28	.53	.33	2.63	2.47	5.38	3.45	2.09	10.87	9.00	8.78	8.00	4.40	4.00
1.59	.11	.70	.34	2.74	2.47	5.53	2.56	1.81	9.90	9.00	8.09	8.00	4.55	4.00
1.40	.22	.45	.33	2.40	2.47	4.50	3.58	2.02	10.10	9.00	8.08	8.00	4.68	4.00
1.40	.12	.65	.39	2.56	2.47	6.03	3.34	1.73	11.10	10.00	9.37	9.00	2.21	2.00
1.54	.25	.42	.35	2.56	2.47	4.15	2.00	1.94	8.09	7.00	6.15	6.00	10.20	10.00
2.05	.07	.25	.21	2.53	2.47	4.38	2.57	.71	7.66	7.00	6.95	6.00	9.30	10.00
2.12	—	.41	.26	2.79	2.47	5.87	3.48	1.70	11.05	11.00	9.35	10.00	7.14*	8.00
1.76	.09	.30	.20	2.35	2.47	5.42	1.85	.33	7.60	10.00	7.27	6.00	10.22	10.00

*No. 294-523 Chlorine 1.17%, equivalent to 1.55% potash, 5.59% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Bowker Fertilizer Co. (Concluded).				
Bowker's Onion Fertilizer	Hadley	$28.12	31	9.27
Bowker's Onion Fertilizer	Hatfield	26.39	219	8.06
" " "	Northampton		446	
Bowker's Lawn and Garden Dressing	Fall River	19.76	252	7.05
" " " "	Springfield		769	
Stockbridge Spec. Com. Man. Potatoes & Vegetables	Fall River		279	
" " " " " " "	Brockton		393	
" " " " " " "	Northampton	26.38	453	10.30
" " " " " " "	Taunton		470	
" " " " " " "	Bridgewater		536	
Stockbridge Sp. Com. Man. for Potatoes & Vegetables	Springfield	27.33	761	10.58
" " " " " " " "	Monson		778	
Bowker's Early Potato Manure	Fall River	25.06	248	14.18
Stockbridge Sp. Com. Man. for Corn & all Gr. Crops	Fall River		284	
" " " " " " " " " " "	Brockton	26.99	394	10.93
" " " " " " " " " " "	Northampton		520	
" " " " " " " " " " "	Bridgewater		533	
Stockbridge Sp. Com. Man. for Corn & all Gr. Crops	Springfield	26.59	762	9.81
Bowker's Complete Alkaline Tobacco Grower	Northampton	27.31	447	3.84
" " " " "	Easthampton		1050	
Stockbridge Sp. Com. Man. for Top Dress. & Forcing	Dighton		251	
" " " " " " " " " "	Fall River		285	
" " " " " " " " " "	Northampton	26.15	455	7.18
" " " " " " " " " "	Concord		491	
" " " " " " " " " "	Bridgewater		538	
Stockbridge Sp. Com. Man. for Top Dress. & Forcing	Springfield	24.07	765	10.56
" " " " " " " " " "	Spencer		955	
Stockbridge Tobacco Manure	Deerfield	34.12	1084	9.94
Bowker's Pulverized Sheep Manure	Newburyport	13.95	494	14.87
" " " "	Leominster		739	
Bowker's Ammoniated Food for Flowers	Boston	19.35	539	4.19
Joseph Breck & Sons, Corp., Boston, Mass.				
Breck's Market Garden Manure	Boston	18.96	364	11.38
Breck's Lawn and Garden Dressing	Boston	26.04	354	9.72
Ram's Head Brand Pulverized Sheep Manure	Boston	12.43	359	5.96
Buffalo Fertilizer Company, Buffalo, N. Y.				
Fish Guano	Springfield	14.15	768	13.47
" "	Sterling		875	
Farmers' Choice	Beverly		633	
" "	Sterling	17.05	890	11.63
" "	W. Boylston		995	
New England Special	Ipswich		552	
" " "	Springfield		770	
" " "	Holyoke	19.56	865	12.33
" " "	Sterling		880	
" " "	W. Boylston		1001	
Celery and Potato Special	Ipswich		556	
" " " "	Beverly	22.60	637	12.30
" " " "	Maynard		996	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.70	.55	.34	.23	2.82	2.47	7.60	2.80	1.60	12.00	11.00	10.40	10.00	8.26*	8.00
1.94	.06	.39	.27	2.66	2.47	7.21	3.48	1.45	12.14	11.00	10.69	10.00	7.17*	8.00
3.71	—	—		3.71	3.29	2.53	2.35	.38	5.26	8.00	4.88	4.00	3.78	5.00
1.93	.42	.54	.44	3.33	3.29	4.27	1.75	2.86	8.88	7.00	6.02	6.00	10.37	10.00
1.98	.24	.72	.40	3.34	3.29	4.18	2.78	1.10	8.06	7.00	6.96	6.00	10.84	10.00
2.13	—	.67	.49	3.29	3.29	4.98	2.97	1.93	9.88	9.00	7.95	8.00	7.02	7.00
2.64	.15	.41	.23	3.43	3.29	6.50	3.28	1.58	11.36	11.00	9.78	10.00	7.27	7.00
2.48	.24	.29	.21	3.22	3.29	4.15	6.35	1.88	12.38	11.00	10.50	10.00	7.09	7.00
.17	.96	1.91	1.36	4.40	4.11	.64	3.73	3.62	7.99	5.00	4.37	4.00	5.45*	5.00
4.08	.04	.46	.20	4.78	4.94	2.98	1.13	1.66	5.77	6.00	4.11	4.00	6.81	6.00
3.79	.37	.31	.19	4.66	4.94	2.23	2.03	1.48	5.74	6.00	4.26	4.00	5.63	6.00
4.16	.50	.47	.35	5.48	5.76	2.02	2.92	2.06	7.00	5.00	4.94	4.00	10.10*	10.00
—	.54	.45	1.13	2.17	1.25	—	—	—	1.76	1.50	—	—	4.09**	2.00
2.52	—	.04	.21	2.88	2.47	—	7.22	1.66	8.88	7.00	7.22	6.00	3.59*	2.00
1.50	.26	.52	.30	2.58	2.47	5.88	2.65	1.81	10.34	10.00	8.53	9.00	2.09	2.00
1.94	.29	1.27	.61	4.11	4.11	3.03	3.43	2.86	9.32	6.00	6.46	5.00	5.62	5.00
.23	.21	.62	1.37	2.43	2.25	—	—	—	1.48	1.75	—	1.50	1.88**	1.50
.49	—	.29	.31	1.09	.80	4.46	4.63	1.73	10.82	10.00	9.09	9.00	2.18	2.00
.54	—	.41	.39	1.34	.80	4.78	3.68	1.60	10.06	9.00	8.46	8.00	5.12	5.00
[illegible]	.07	.33	.24	1.84	1.60	5.98	3.54	1.35	10.87	10.00	9.52	9.00	5.16	5.00
.94	.10	.37	.31	1.72	1.60	5.88	2.26	1.50	9.64	9.00	8.14	8.00	10.40	10.00

*No. 51 Chlorine .54% equivalent to .72% potash, 7.54% potash as sulfate.
" 219-446 " .48% " " .64% " 6.53% " " "
" 447-1050 " .19% " " .25% " 5.20% " " "
" 1084 " .82% " " 1.09% " 9.01% " " "
" 539 " 1.88% " " 2.50% " 1.09% " " "

**Potash figured as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture
Buffalo Fertilizer Co. (Concluded).				
Vegetable and Potato	Ipswich	$24.16	553	12.93
" " "	Beverly		639	
" " "	Springfield		740	
" " "	Holyoke		867	
" " "	Sheffield		1019	
High Grade Manure	Ipswich	26.97	554	13.11
" " "	Beverly		629	
" " "	Maynard		997	
" " "	Littleton		1015	
" " "	Sheffield		1018	
Buffalo Tobacco Producer	Florence	28.49	1095	9.62
Top Dresser	Springfield	29.63	771	11.23
" "	Sheffield		1020	
The E. D. Chittenden Co., Bridgeport, Ct.				
Chittenden's Potato and Grain	Hatfield	23.14	199	7.63
" " " "	N. Amherst		635	
Chittenden's Complete Tobacco & Onion Grower	Sunderland	24.28	21	6.30
" " " " " "	Sunderland		26	
" " " " " "	Sunderland		418	
" " " " " "	N. Amherst		634	
Chittenden's Complete Tobacco and Onion Grower	Hadley	26.01	40	9.07
Chittenden's Complete Tobacco and Onion Grower	Sunderland	25.91	51	8.04
Chittenden's Complete Tobacco and Onion Grower	N. Amherst	25.71	60	7.42
Chittenden's Grain and Vegetable	Feeding Hills	25.24	899	6.43
" " " "	Mittineague		1056	
Chittenden's Tobacco Special	Hatfield	26.66	181	6.54
Chittenden's Tobacco Special	Sunderland	26.56	382	5.30
Chittenden's Special Formula Fish and Potash	Hatfield	25.44	175	6.31
" " " " " "	Feeding Hills		900	
" " " " " "	Mittineague		1075	
Clay & Son, Stratford, London, England.				
Clay's Fertilizer	Boston	20.80	344	10.37
" "	Boston		349	
The Coe-Mortimer Co., 51 Chambers St., N. Y. City.				
E. Frank Coe's Celebrated Special Potato Fertilizer	Whitman	17.73	691	11.23
" " " " " "	Westfield		917	
" " " " " "	Lee		1026	
E. Frank Coe's Columbian Corn and Potato	Westfield	15.47	916	9.37
E. Frank Coe's Complete Manure with 10% potash	W. Springfield	23.56	914	10.74
" " " " " " " "	Easthampton		1049	
E. Frank Coe's Excelsior Potato Fertilizer	Millis	23.33	532	9.73
E. Frank Coe's Red Brand Excelsior Guano	Millis	25.55	526	9.63
" " " " " "	Concord		682	
E. Frank Coe's Gold Brand Excelsior Guano	Millis	22.57	527	10.37
" " " " " "	S. Williamstown		973	
E. Frank Coe's H.G. Ammo. Bone Superphosphate	Millis	17.32	534	11.10
" " " " " "	Westfield		922	
" " " " " "	Lee		1017	
E. Frank Coe's New Englander Corn & Potato Fert.	Whitman	13.45	672	9.43
" " " " " " " "	S. Williamstown		976	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.94	.16	.43	.35	2.88	2.40	5.68	2.46	1.40	9.54	9.00	8.14	8.00	7.70	7.00
2.07	.09	.57	.44	3.17	3.30	4.95	2.63	2.02	9.60	8.00	7.58	7.00	10.10	10.00
2.26	.15	1.10	1.06	4.57	4.50	4.18	2.02	.13	6.33	6.00	6.20	5.00	6.52*	5.50
2.76	.02	1.34	.75	4.87	5.70	5.10	2.13	1.30	8.53	7.00	7.23	6.00	6.65	5.00
2.11	.14	.45	.40	3.10	3.30	5.88	1.88	1.14	8.90	10.00	7.76	8.00	6.08	6.00
1.89	.02	.65	.54	3.10	3.30	7.65	1.10	.13	8.88	10.00	8.75	8.00	5.38*	5.00
1.85	.16	.76	.64	3.41	3.30	7.40	1.38	.08	8.86	10.00	8.78	8.00	5.96*	5.00
1.76	.25	.74	.63	3.38	3.30	7.18	1.96	.20	9.34	10.00	9.14	8.00	5.60*	5.00
1.25	.85	.75	.57	3.42	3.30	6.98	1.45	.22	8.65	10.00	8.43	8.00	5.66*	5.00
1.80	.14	.76	.58	3.28	2.47	8.13	1.17	.16	9.46	10.00	9.30	8.00	5.14*	6.00
1.73	.13	1.38	1.26	4.53	4.50	2.33	1.45	.10	3.88	5.00	3.78	3.00	6.63*	5.50
2.44	.27	1.21	.88	4.80	4.50	3.23	.24	.61	4.08	5.00	3.47	3.00	5.92*	5.50
1.92	—	.77	.60	3.29	2.47	8.00	1.50	.12	9.62	6.00	9.50	—	5.21*	4.00
2.42	—	1.22	.77	4.41	4.00	.15	3.05	6.08	9.28	7.00	3.20	1.12	.28	.08
.86	.22	.36	.37	1.81	1.65	5.23	2.97	1.63	9.83	9.00	8.20	8.00	4.14	4.00
.76	.09	.25	.22	1.32	1.23	5.93	3.05	1.40	10.38	9.50	8.98	8.50	2.93	2.50
1.43	.22	.47	.41	2.53	2.47	4.20	2.15	1.10	7.45	7.00	6.35	6.00	10.26	10.00
1.34	.25	.50	.46	2.55	2.47	6.03	2.05	1.00	9.08	8.00	8.08	7.00	8.12	8.00
1.80	.15	.80	.48	3.23	3.30	6.75	1.87	1.28	9.90	9.00	8.62	8.00	7.16	7.00
1.31	.17	.65	.40	2.53	2.47	5.80	2.45	1.73	9.98	9.00	8.25	8.00	6.75	6.00
.80	.24	.44	.39	1.87	1.85	5.30	3.02	2.09	10.41	9.00	8.32	8.00	3.04	3.00
.14	.10	.39	.28	.91	.80	5.63	2.37	1.03	9.03	8.50	8.00	7.50	3.13	3.00

*No.	1095	Chlorine	.17%	equivalent to	.23%	potash,	6.29%	potash as sulfate.
"	21-26-418-634	"	.19%	" "	.26%	"	5.12%	" " "
"	40	"	.31%	" "	.42%	"	5.54%	" " "
"	51	"	.20%	" "	.27%	"	5.33%	" " "
"	60	"	.53%	" "	.71%	"	4.95%	" " "
"	899-1056	"	.16%	" "	.21%	"	4.93%	" " "
"	181	"	.53%	" "	.71%	"	5.92%	" " "
"	382	"	.12%	" "	.15%	"	5.77%	" " "
"	175-900-1075	"	.11%	" "	.15%	"	5.06%	" " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
The Coe-Mortimer Co. (Concluded).				
E. Frank Coe's Special Grass Top Dressing	Millis	$23.57	525	9.30
" " " " " "	Whitman		694	
Peruvian Vegetable Grower	Taunton	29.37	476	6.85
" " "	Millis		524	
Peruvian Grass Top Dressing	Lynn	39.15	699	7.05
" " " "	Sterling		834	
Warner's Special Onion Fertilizer	Hatfield	27.95	241	7.55
Smith's Market Garden Special	W. Springfield	30.00	747	8.36
Cowls' Special Brand No. 1 Fertilizer	N. Amherst	28.16	126	8.30
Cowls' Special Brand No. 2 Fertilizer	N. Amherst	29.45	134	6.72
E. Frank Coe's XXV Ammoniated Bone Phosphate	Whitman	14.32	690	11.86
Peruvian Tobacco Fertilizer	Easthampton	33.81	1048	6.97
The Eastern Chemical Co., 37 Pittsburg St., Boston.				
I M P Plant Food	Boston	94.71	540	.22
Essex Fertilizer Co., 39 N. Market St., Boston, Mass.				
Essex Grass and Top Dressing	Taunton	28.13	233	10.85
" " " " "	W. Brookfield		837	
Essex Tobacco Starter and Grower	Southwick	25.66	926	4.25
Essex Potato Grower with 10% Potash	Spencer	22.30	981	5.74
Essex XXX Fish and Potash	Taunton	16.05	225	8.69
" " " " "	Billerica		613	
" " " " "	Spencer		980	
Essex Market Garden and Potato Manure	Billerica	20.24	617	9.34
" " " " " "	Leominster		814	
" " " " " "	Southwick		932	
Essex Complete Man. for Potatoes, Roots & Veg'bles	Taunton	26.12	228	9.09
" " " " " " " "	Warren		784	
" " " " " " " "	Leominster		316	
" " " " " " " "	Spencer		983	
Essex Complete Manure for Corn, Grain and Grass	W. Brookfield	27.52	781	7.69
" " " " " " " "	Spencer		984	
Essex Special Potato Phosphate	W. Brookfield	20.72	834	10.32
" " " "	Sterling		878	
Essex A 1 Superphosphate	Leominster	13.47	812	5.48
" " "	Warren		835	
C. W. Hastings, Dorchester, Mass.				
Ferti-Flora Liquid Fertilizer	Boston	18.16	1055	79.25
The Hubbard Fertilizer Co., Baltimore, Md.				
Hubbard's 5% Royal Seal	Boston	24.33	577	9.28
Hubbard's Special Potato	Millis	26.09	528	8.75
" " "	Boston		575	
Hubbard's Blood, Bone and Potash	Boston	24.79	574	9.14
Hubbard's Blood, Bone and Potash	Billerica	24.15	639	11.68
Hubbard's Royal Ensign	Boston	19.38	573	8.43
Hubbard's Farmers' I. X. L.	Boston	16.13	576	8.37
Lister's Agricultural Chemical Works, Newark, N. J.				
Lister's High Grade Special for Spring Crops	Marblehead	23.25	497	11.75
" " " " " " "	Hadley		516	
Lister's High Grade Special for Spring Crops	Pepperell	24.58	721	11.00

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.88	.20	1.68	.70	4.46	4.94	2.65	2.07	1.76	6.48	5.00	4.72	4.00	4.02	3.00
2.51	.29	.23	.25	3.28	3.30	4.83	3.34	.94	9.11	9.00	8.17	8.00	10.31*	9.00
6.84	—	.53	.51	7.88	8.24	1.08	4.22	1.84	7.14	6.00	5.30	4.50	7.42*	6.00
1.70	.25	.81	.34	3.10	3.00	4.44	3.58	3.24	11.26	10.00	8.02	9.00	9.48*	9.00
2.98	.10	.51	.41	4.00	4.00	5.55	2.33	1.38	9.26	9.00	7.88	8.00	8.55*	8.00
2.15	.52	.96	.48	4.11	4.00	4.57	2.42	1.79	8.78	7.00	6.99	6.00	6.68*	6.00
2.29	.31	.84	.36	3.80	4.00	4.02	3.60	1.38	9.00	8.00	7.62	7.00	8.86*	8.00
.18	.42	.31	.30	1.21	.80	6.35	2.56	.61	9.52	9.50	8.91	8.50	2.13	1.50
1.78	.52	1.48	.94	4.72	4.96	2.13	5.94	.51	8.58	7.00	8.07	6.00	9.67*	10.00
13.90		.10	—	14.00	13.00	24.55	.30	—	24.85	25.30	24.85	25.00	24.90**	24.60
1.51	.70	1.06	.63	3.90	4.10	5.80	1.84	1.22	8.86	8.00	7.64	7.00	8.10	8.00
1.99	.85	.57	.44	3.85	4.10	1.50	3.94	1.63	7.07	5.00	5.44	4.00	6.67*	6.00
1.19	.51	.37	.26	2.33	2.46	3.78	2.28	.68	6.74	7.00	6.06	6.00	10.06	10.00
.77	.27	.41	.35	1.80	2.00	5.40	2.48	.52	8.40	9.00	7.88	8.00	3.00	3.00
.35	.94	.41	.39	2.09	2.00	6.15	2.68	1.02	9.85	9.00	8.83	8.00	5.15	5.00
.68	.47	1.20	.67	3.02	3.28	4.40	2.42	.40	7.22	7.00	6.82	6.00	10.50	10.00
.35	.56	1.49	.94	3.34	3.28	4.25	1.81	.86	6.92	7.00	6.06	6.00	11.08	10.00
1.10	.09	.62	.58	2.39	2.46	5.78	2.29	.40	8.47	9.00	8.07	8.00	5.87	6.00
.21	.62	.28	.32	1.43	1.25	4.03	2.63	.99	7.65	8.00	6.66	7.00	2.36	2.00
3.27	—	—	—	3.27	3.25	3.90	—	—	3.90	3.67	3.90	3.67	4.05†	3.30
2.44	.48	.50	.48	3.90	4.10	3.85	3.45	1.25	8.55	7.00	7.30	6.00	4.76	5.00
1.91	.13	.66	.60	3.30	3.28	1.98	3.99	2.04	8.01	7.00	5.97	6.00	10.26	10.00
2.45	.17	.33	.37	3.32	3.28	3.85	4.01	2.47	10.33	9.00	7.86	8.00	6.73	7.00
2.32	.08	.41	.40	3.21	3.28	3.83	3.98	1.76	9.57	9.00	7.81	8.00	6.80	7.00
1.29	.13	.51	.46	2.39	2.46	3.34	4.50	1.45	9.29	9.00	7.84	8.00	4.41	4.00
.79	.29	.34	.41	1.83	1.64	2.19	5.98	1.58	9.75	9.00	8.17	8.00	2.58	2.00
.69	.47	.42	.35	1.93	1.65	5.42	2.59	1.68	9.69	9.00	8.01	8.00	10.17	10.00
1.84	.09	.22	.16	2.31	1.65	5.00	3.10	.96	9.06	9.00	8.10	8.00	11.01	10.00

*No. 476-524 Chlorine .25% equivalent to .33% potash, 9.98% potash as sulfate.
" 699-884 " .94% " " 1.25% " 6.17% " " "
" 241 " 3.65% " " 4.83% " 4.65% " " "
" 747 " .35% " " .46% " 8.09% " " "
" 126 " .63% " " .84% " 5.84% " " "
" 134 " .77% " " 1.02% " 7.84% " " "
" 1048 " .96% " " 1.27% " 8.40% " " "
" 926 " .50% " " .66% " 6.01% " " "
**No. 540 Chlorine .12% equivalent to .16% potash, 24.74% potash as nitrate valued at 5¼ cents a pound.
†No. 1055 No chlorine, .37% potash as sulfate, 3.68% potash as nitrate, valued at 5¼ cents a pound.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Lister's Agricultural Chemical Works. (Concluded).				
Lister's Success Fertilizer	Hingham		677	
" " "	Pepperell	$15.77	719	12.00
" " "	Webster		873	
Lister's Special Corn Fertilizer	Fall River		352	
" " " "	S. Deerfield	15.00	461	12.62
" " " "	Amherst		531	
Lister's Special Potato Fertilizer	Fall River		353	
" " " "	S. Deerfield	17.55	457	12.57
" " " "	Amherst		593	
Lister's Special Potato Fertilizer	Hingham	17.36	673	9.47
" " " "	Pepperell		723	
Lister's Potato Manure	Hatfield	25.93	240	11.33
Lister's Potato Manure	S. Deerfield	25.61	460	11.66
Lister's Special Tobacco Fertilizer	S. Deerfield	20.06	458	11.00
Lister's 10% Potato Grower	S. Deerfield	27.23	459	11.50
Lister's 10% Potato Grower	Pepperell	24.87	720	9.74
Lister's Standard Grass Fertilizer	Fall River	19.63	363	13.66
Lister's Standard Grass Fertilizer	Webster	20.00	874	10.25
Lister's Complete Tobacco Manure	Hatfield	25.01	203	7.14
James E. McGovern, Andover, Mass.				
Andover Animal Fertilizer	S. Lawrence	22 33	570	11.30
Mapes' Formula & Peruvian Guano Co., New York City.				
Mapes' Potato Manure	Taunton		223	
" " "	Northampton	27.54	521	6.63
" " "	Fitchburg		804	
" " "	Springfield		923	
Mapes' Tobacco Starter, Improved	Westfield		906	
" " " "	Conway	25.33	967	8.07
" " " "	Southwick		1046	
Mapes' Tobacco Manure, Wrapper Brand	Westfield		396	
" " " " "	Conway	40.33	963	6.90
" " " " "	Southwick		1037	
Mapes' Fruit and Vine Manure	Worcester	23.92	340	5.88
Mapes' Economical Potato Manure	Boston	25.61	372	11.36
" " " "	Worcester		806	
Mapes' Vegetable or Complete Man. for Light Soils	Boston	30.63	356	5.45
" " " " " " " " "	Springfield		924	
Mapes' Average Soil Complete Manure	Boston	26.04	367	7.46
" " " " "	Fitchburg		823	
Mapes' Cauliflower and Cabbage Manure	Boston	25.65	351	7.37
" " " " "	Fitchburg		830	
Mapes' Corn Manure	Taunton		227	
" " "	Northampton	21.74	519	9.66
" " "	Fitchburg		829	
" " "	Springfield		915	
Mapes' Grass and Grain Spring Top Dressing	Boston		371	
" " " " " " " "	Northampton	23.77	511	7.04
" " " " " " " "	Fitchburg		797	
Mapes' Lawn Top Dressing	Taunton	14.92	234	10.36
Mapes' Complete Manure for General Use	Boston	23.62	365	5.93
Mapes' Cereal Brand	Taunton	16.59	224	10.17

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.36	.39	.27	.24	1.46	1.23	5.90	2.88	1.32	10.10	10.00	8.78	9.00	2.95	2.00
.23	.42	.29	.33	1.27	1.23	6.03	1.38	1.91	9.32	9.00	7.91	8.00	3.06	3.00
.24	.64	.53	.49	1.90	1.65	4.95	2.76	2.37	10.08	9.00	7.71	8.00	3.33	3.00
.32	.29	.43	.34	1.38	1.65	5.30	3.12	1.98	10.40	9.00	8.42	8.00	3.60	3.00
2.14	.51	.42	.37	3.44	3.29	6.70	1.42	1.91	10.03	9.00	8.12	8.00	7.12	7.00
1.93	.44	.50	.47	3.34	3.29	6.13	2.17	1.76	10.06	9.00	8.30	8.00	6.96	7.00
.29	.72	.67	.60	2.28	2.06	5.61	2.71	1.94	10.26	9.00	8.32	8.00	3.52*	3.00
1.82	.66	.50	.47	3.45	3.29	4.18	2.27	2.25	8.70	7.00	6.45	6.00	10.12	10.00
2.35	.13	.29	.19	2.96	3.29	3.76	2.34	1.66	7.76	7.00	6.10	6.00	10.45	10.00
1.08	.61	.43	.41	2.53	2.47	6.60	2.70	1.46	10.76	10.00	9.30	9.00	2.21	2.00
1.48	.22	.59	.32	2.61	2.47	5.70	3.76	1.84	11.30	10.00	9.46	9.00	2.29	2.00
3.46	.31	.37	.36	4.50	4.11	1.38	2.78	1.71	5.87	5.00	4.16	4.00	5.35*	5.00
.82	.82	1.16	.98	3.78	3.00	trace	6.28	2.60	8.88	6.00	6.28	5.00	3.30	3.00
3.14	.05	.30	.22	3.71	3.71	1.30	7.17	1.17	9.64	8.00	8.47	8.00	7.42*	6.00
2.84	.13	.92	.49	4.38	4.12	—	8.53	4.00	12.53	8.00	8.53	6.00	1.86*	1.00
3.91	.16	1.56	.85	6.48	6.18	—	3.91	1.45	5.36	4.50	3.91	—	10.50*	10.50
1.20	--	.46	.43	2.09	1.65	.13	5.23	2.09	7.45	7.00	5.36	5.00	11.09*	10.00
2.64	.08	.32	.43	3.47	3.29	.55	5.40	1.35	7.30	6.00	5.95	4.00	8.16*	8.00
4.14	—	.28	.42	4.84	4.94	.80	6.81	1.17	8.78	8.00	7.61	6.00	7.54*	6.00
3.51	.12	.28	.29	4.20	4.12	1.00	6.46	.96	8.42	8.00	7.46	7.00	5.20*	5.00
3.25	—	.55	.36	4.16	4.12	.58	6.03	1.20	7.81	6.00	6.61	6.00	6.63	6.00
1.59	.17	.46	.35	2.57	2.47	.48	7.38	2.34	10.20	10.00	7.86	8.00	6.47	6.00
3.53	--	.89	.53	4.95	4.94	.28	5.88	1.86	8.02	6.00	6.16	5.00	7.09	7.00
2.66	--	.06	.15	2.87	2.47	.58	2.36	1.04	3.98	3.50	2.94	—	2.95	2.50
2.75	.20	.24	.38	3.57	3.29	.33	7.79	2.96	11.08	10.00	8.12	8.00	4.36	4.00
.97	.07	.50	.47	2.01	1.65	.38	5.93	2.70	9.01	8.00	6.31	6.00	3.86	3.00

*No. 458 Chlorine .62% equivalent to .82% potash, 2.70% potash as sulfate.
" 208 " .42% " " .58% " 4.77% " " "
" 223-521-804-923 " .63% " " .81% " 6.61% " " "
" 906-967-1046 " .80% " " 1.07% " .79% " " "
" 896-969-1037 " 1.40% " " 1.86% " 2.64% " " " 6.00% potash as carbonate, 11.20% total potash.

*No. 840 Chlorine .76% equivalent to 1.01% potash, 10.08% potash as sulfate.
" 372-806 " .68% " " .90% " 7.26% " " "
" 356-924 " .77% " " 1.02% " 6.52% " " "
" 367-823 " .60% " " .80% " 1.49% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Mapes' Formula & Peruvian Guano Co. (Concluded).				
Mapes' Top Dresser, Improved, Full Strength	Springfield	$43.60	925	6.22
" " " " " "	Southwick		930	
Mapes' Tobacco Ash Constituents	Westfield	24.56	905	5.03
Mapes' Complete Manure with 10% Potash	Enfield	20.15	1054	9.60
Mapes' Top Dresser, Improved, Half Strength	Greenfield	20.36	979	9.97
Mapes' Complete Manure "A" Brand	Springfield	21.05	913	9.54
The National Fertilizer Co., 92 State St., Boston, Mass.				
Chittenden's Complete Root and Grain Fertilizer	Sunderland	25.10	161	11.92
Chittenden's Complete Root and Grain Fertilizer	Sunderland	24.80	170	10.93
Chittenden's Complete Root and Grain Fertilizer	Sunderland	23.36	423	12.03
" " " " " "	Saundersville		303	
" " " " " "	S. Acton		906	
Chittenden's Fish and Potash	N. Westport	18.11	249	8.50
" " " "	S. Acton		993	
Chittenden's Fish and Potash	W. Springfield	20.06	415	8.23
Chittenden's XXX Fish and Potash	N. Westport	17.33	246	8.98
" " " " "	N. Hadley		336	
" " " " "	Hadley		600	
Chittenden's XXX Fish and Potash	W. Springfield	18.10	912	8.73
Chittenden's Market Garden Fertilizer	Sunderland	22.50	146	11.60
" " " "	N. Westport		250	
Chittenden's Ammoniated Bone Phosphate	Leominster	16.33	793	11.14
" " " "	Saundersville		811	
Chittenden's High Grade Special Tobacco Fertilizer	Sunderland	34.20	27	7.49
Chittenden's Potato Phosphate	Dighton	20.72	263	11.31
" " "	N. Westport		319	
Chittenden's Complete Tobacco Fertilizer	Sunderland	26.05	19	10.96
Chittenden's Complete Tobacco Fertilizer	Hadley	24.25	28	8.97
Chittenden's Complete Tobacco Fertilizer	Bradstreet	24.30	78	8.12
Chittenden's Complete Tobacco Fertilizer	Bradstreet	24.75	177	8.55
Chittenden's Complete Tobacco Fertilizer	N. Hadley	24.23	295	9.13
Chittenden's Complete Tobacco Fertilizer	W. Springfield	24.45	414	7.66
Chittenden's Complete Tobacco Fertilizer	E. Whately	25.63	1087	6.51
Chittenden's Connecticut Valley Tobacco Grower	Bradstreet	35.07	4	9.16
Chittenden's Connecticut Valley Tobacco Grower	N. Hadley	32.63	121	10.61
Chittenden's Connecticut Valley Tobacco Starter	N. Hadley	34.40	103	6.55
Chittenden's Tobacco Special with Carbonate Potash	N. Hadley	23.56	119	11.48
Chittenden's Tobacco Special with Carbonate Potash	N. Hadley	23.90	154	12.27
Chittenden's Tobacco Special with Carbonate Potash	N. Hadley	30.00	300	10.99
Chittenden's Tobacco Special with Carbonate Potash	N. Hadley	23.04	338	11.25
" " " " " "	Hadley		509	
" " " " " "	Hadley		607	
" " " " " "	N. Hadley		700	
Chittenden's Tobacco Special with Sulfate Potash	E. Whately	26.73	1091	6.00
Chittenden's Complete Grass Fertilizer	Saundersville	24.03	802	11.11
" " " "	Leominster		813	
Chittenden's Eureka Potato Fertilizer	Dighton	23.10	247	11.20
" " " "	Saundersville		823	

*No. 925–930 Chlorine .26% equivalent to .35% potash, 3.74% potash as sulfate.
" 905 " 1.61% " " 2.14% " 7.58% " " " 5.50% potash as carbonate, 15.35% total potash.
*No. 979 Chlorine .07% equivalent to .09% potash, 2.18% potash as sulfate.
" 913 " 2.34% " " 3.11% " .35% " " "
" 27 " 1.46% " " 1.95% " 7.68% " " "
" 19 " .53% " " .71% " 4.65% " " "
" 28 " .58% " " .77% " 4.73% " " "
" 78 " .49% " " .66% " 4.65% " " "
" 177 " .46% " " .61% " 4.78% " " "
" 295 " .26% " " .35% " 5.13% " " "
" 414 " .35% " " .46% " 4.79% " " "
" 1087 " .22% " " .29% " 4.94% " " "
*No. 4 " .46% " " .61% " 1.61% " " " 5.81% potash as carbonate, 8.52% total potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
10.00	—	.15	.14	10.29	9.88	.35	5.83	.94	7.12	8.00	6.18	—	4.09*	4.00
.18	.06	.25	.28	.77	.50	.32	1.54	4.08	5.94	5.70	1.86	—	15.22*	15.00
1.03	.05	.70	.45	2.23	2.06	.43	3.04	1.73	5.20	5.00	3.47	3.00	10.21	10.00
4.42	—	.23	.10	4.75	4.94	.35	2.18	1.48	4.01	4.00	2.53	—	2.27*	2.00
2.20	.23	.23	.18	2.84	2.47	1.25	9.35	1.60	12.20	—	10.60	10.00	3.46*	2.50
1.70	.58	.51	.41	3.20	3.29	6.23	1.77	4.20	12.20	9.00	8.00	8.00	6.08	6.00
1.86	.13	1.07	.37	3.43	3.29	5.55	2.51	1.66	9.72	9.00	8.06	8.00	5.91	6.00
1.82	.04	.61	.48	2.95	3.29	6.50	2.10	1.38	9.98	9.00	8.60	8.00	6.45	6.00
1.75	03	.48	24	2.50	2.88	4.13	2.63	.84	7.60	7.00	6.76	6.00	3 90	4.00
1.43	—	.99	.44	2.86	2.88	4.18	1.79	2.37	8.34	7.00	5.97	6.00	4.44	4.00
1.36	.25	.50	.36	2.47	2.47	3.93	2.32	1.66	7.91	6.00	6.25	5.00	3.01	3.00
1.75	.02	.49	.29	2.55	2.47	2.91	3.57	1.20	7.63	6.00	6.48	5.00	3.91	3.00
1.50	.26	.53	.36	2.65	2.47	6.31	2.00	1.15	9.46	9.00	8.31	8.00	6.50	6.00
.78	.21	.39	.32	1.70	1.65	5.83	2.87	1.56	10.26	9.00	8.70	8.00	2.46	2.00
2.54	.06	1.89	.90	5.39	5.76	3.48	2.49	.61	6.58	6.00	5.97	5.00	9.63*	10.00
1.31	.07	.43	.25	2.06	2.06	6.29	2.20	1.33	9.82	9.00	8.49	8.00	6.59	6.00
1.13	.66	.99	.58	3.36	3.29	6.86	2.05	1.40	10.31	9.00	8.91	8.00	5.36*	5.00
2.18	.55	.35	.23	3.31	3.29	5.18	2.28	1.68	9.14	9.00	7.46	8.00	5.50*	5.00
1.94	.13	.78	.36	3.21	3.29	5.58	2.66	1.20	9.44	9.00	8.24	8.00	5.31*	5.00
2.15	.18	.62	.35	3.30	3.29	5.80	2.57	1.15	9.52	9.00	8.37	8.00	5.39*	5.00
2.66	.18	.34	.15	3.33	3.29	5.59	2.02	1.53	9.14	9.00	7.61	8.00	5.48*	5.00
1.68	.36	.84	.29	3.17	3.29	5.65	2.06	2.73	10.44	9.00	7.71	8.00	5.25*	5.00
1.73	.05	1.05	.51	3.34	3.29	7.40	1.89	.61	9.90	9.00	9.29	8.00	5.23*	5.00
.22	1.21	2.64	1.43	5.50	4.94	trace	2.49	1.94	4.43	4.00	2.49	1.00	8.03*	8.00
.22	.23	2.78	1.64	4.87	4.94	.23	2.81	.58	3.68	4.00	3.10	1.00	7.68*	8.00
5.45	.44	.88	.97	7.74	8.23	.55	3.85	.86	5.26	4.00	4.40	3.00	3.85*	2.50
.31	.94	2.05	1.35	4.65	4.53	trace	3.62	2.12	5.74	4.00	3.62	3.00	5.88*	5.50
.32	.76	2.17	1.34	4.59	4.53	trace	3.88	1.86	5.74	4.00	3.88	3.00	6.33*	5.50
.39	.99	2.13	1.22	4.73	4.53	trace	3.60	1.63	5.23	4.00	3.60	3.00	6.53*	5.50
.27	.53	2.39	1.45	4.64	4.53	.55	3.92	1.73	6.20	4.00	4.47	3.00	5.72*	5.50
.24	.35	2.50	1.46	4.55	4.53	1.53	3.02	1.63	6.18	4.00	4.55	3.00	4.94*	5.50
2.33	.09	.79	.46	3.67	4.11	3.70	2.53	1.96	8.24	7.00	6.28	6.00	6.03	5.00
1.54	—	.50	.35	2.39	2.47	4.05	2.41	1.60	8.06	7.00	6.46	6.00	10.08	10.00

*No. 121 Chlorine .17% equivalent to .24% potash, 1.12% potash as sulfate, 6.32% potash as carbonate, 7.71% total potash.

*No. 108 Chlorine .94% equivalent to 1.25% potash, 2.60% potash as sulfate.

*No. 119 Chlorine 1.11% equivalent to 1.48% potash, 1.82% potash as sulfate, 2.58% potash as carbonate, 6.38% total potash.

*No. 154 Chlorine .98% equivalent to 1.31% potash, 2.50% potash as sulfate, 2.52% potash as carbonate 7.00% total potash.

*No. 300 Chlorine .62% equivalent to .82% potash, 2.42% potash as sulfate, 3.29% potash as carbonate 6.56% total potash.

*No. 338-599-607-760 Chlorine .64% equivalent to .85% potash, 4.18% potash as sulfate, .69% potash as carbonate, 6.28% total potash.

*No. 1091 Chlorine .11% equivalent to .15% potash, 4.79% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Natural Guano Co., Aurora, Ill.				
Pulverized Sheep Manure	Worcester	$12.03	796	7.35
New England Fertilizer Co., 40A N. Market St., Boston.				
New England High Grade Potato Fertilizer	Brockton	22.12	392	9.76
New England Corn and Grain Fertilizer	New Bedford	13.33	216	6.53
" " " " " "	Natick		395	
" " " " " "	Marblehead		490	
New England Complete Manure	Brockton	27.73	391	3.74
New England Corn Phosphate	Brockton	17.19	401	6.67
" " " "	Marblehead		477	
" " " "	Billerica		636	
New England Superphosphate	New Bedford	20.51	196	9.30
" " "	Natick		409	
" " "	Feeding Hills		907	
New England Potato Fertilizer	New Bedford	17.80	209	6.89
" " " "	Natick		347	
" " " "	Brockton		390	
" " " "	Marblehead		493	
Olds & Whipple, Hartford, Ct.				
O. & W. Complete Tobacco Fertilizer	Hadley	27.23	29	8.21
O. &. W. Complete Tobacco Fertilizer	Bradstreet	28.18	75	8.26
" " " "	N. Hadley		110	
" " " "	E. Whately		1033	
O. & W. Complete Tobacco Fertilizer	N. Hadley	27.65	115	8.96
O. & W. Complete Tobacco Fertilizer	N. Hadley	26.95	122	10.01
O. & W. Complete Tobacco Fertilizer	N. Hadley	27.00	309	11.65
O. & W. Complete Onion Fertilizer	N. Hadley	24.45	123	13.33
" " " "	N. Hadley		148	
" " " "	N. Hadley		165	
" " " "	Hatfield		179	
" " " "	Sunderland		420	
O. & W. Complete Grass Fertilizer	Sunderland	24.25	162	14.09
" " " "	Hatfield Center		193	
" " " "	Sunderland		421	
O. & W. Complete Corn and Potato Fertilizer	Sunderland	24.92	163	12.17
O. & W. High Grade Potato Fertilizer	Southwick	29.30	605	7.14
" " " " "	Hadley		1043	
O. & W. Fish and Potash	Hadley	18.93	606	9.21
O. & W. Special Onion Fertilizer	N. Hadley	23.75	128	12.98
O. & W. Special Onion Fertilizer	N. Hadley	23.88	159	13.30
O. & W. Special Onion Fertilizer	Sunderland	24.23	429	11.20
Parmenter & Polsey Fert. Co., 40 N.Market St., Boston.				
P. & P. Aroostook Special	Adams	28.50	1025	7.82
P. & P. Maine Potato Fertilizer	Marblehead	26.19	496	8.44
P. & P. Plymouth Rock Brand Fertilizer	N. Attleboro	20.03	656	9.05
P. & P. Special Potato Fertilizer	N. Attleboro	26.27	354	9.13
P. & P. Potato Fertilizer	N. Attleboro	13.02	648	5.13
" " "	Adams		1028	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
—	.56	.47	1.23	2.31	2.25	.77	.75	.02	1.54	1.75	1.52	1.50	1.90†	1.50
1.22	.37	.58	.30	2.47	2.46	5.74	2.71	.56	9.01	9.00	8.45	8.00	6.80	6.00
.19	.78	.23	.21	1.41	1.23	4.68	2.77	.84	8.29	8.00	7.45	7.00	2.10	2.00
.13	.96	1.58	.67	3.39	3.28	4.15	2.44	.79	7.38	7.00	6.59	6.00	10.50	10.00
.08	.79	.52	.35	1.74	1.64	5.27	3.00	1.45	9.72	9.00	8.27	8.00	3.41	3.00
.82	.91	.39	.34	2.46	2.46	6.67	1.91	.86	9.44	9.00	8.58	8.00	4.35	4.00
.43	.57	.42	.30	1.72	1.64	7.78	.16	.96	8.90	8.00	7.94	7.00	4.67	4.00
.40	1.68	1.25	1.30	4.63	4.50	trace	3.06	.28	3.34	3.50	3.06	3.00	5.54*	5.50
.51	1.20	1.46	1.42	4.59	4.50	.13	3.15	.18	3.46	3.50	3.28	3.00	5.60*	5.50
.60	1.42	1.55	1.22	4.79	4.50	trace	2.96	.18	3.14	3.50	2.96	3.00	5.58*	5.50
.31	1.23	1.80	1.34	4.68	4.50	trace	2.96	.08	3.04	3.50	2.96	3.00	5.70*	5.50
.54	2.44	1.37	1.07	4.58	4.50	trace	2.76	.54	3.30	3.50	2.76	3.00	5.55**	5.50
1.12	.20	1.04	1.03	3.39	3.30	.96	5.66	1.88	8.50	7.00	6.62	6.00	7.03	6.50
1.05	.36	1.18	1.04	3.63	3.30	.70	5.94	1.66	8.30	7.00	6.64	6.00	5.81	6.00
.89	.49	1.26	1.05	3.69	3.30	.64	5.78	1.42	7.84	7.00	6.42	6.00	6.55	6.00
.80	62	1.27	1.07	3.76	3.30	4.02	2.60	1.12	7.74	7.00	6.62	6.00	10.10*	10.00
.27	.20	1.16	.89	2.52	2.50	2.72	3.84	1.86	8.42	6.00	6.56	5.00	3.86	3.00
1.10	.12	.74	.69	2.65	2.50	1.44	8.21	.58	10.23	—	9.65	8.00	5.91*	6.00
1.20	.18	.84	.70	2.92	2.50	1.53	6.63	1.10	9.26	—	8.16	8.00	6.15*	6.00
1.45	.15	.75	.58	2.93	2.50	1.58	6.57	1.35	9.50	—	8.15	8.00	6.37*	6.00
1.47	.98	.68	.37	3.50	3.69	5.46	2.16	.40	8.02	8.00	7.62	7.00	10.75	10.00
.60	.56	1.37	.70	3.23	3.28	4.44	1.89	.84	7.17	7.00	6.33	6.00	9.85	10.00
1.15	.79	.34	.29	2.57	2.46	5.74	2.33	.94	9.01	9.00	8.07	8.00	4.08	4.00
1.57	.85	.55	.37	3.34	3.28	5.80	2.40	1.14	9.34	9.00	8.20	8.00	7.95	7.00
.22	.64	.50	.29	1.65	1.64	3.33	3.37	.92	8.12	7.00	7.20	6.00	6.28	6.00

†No. 796 Potash figured as sulfate.

*No. 29 Chlorine .45% equivalent to .59% potash, 2.06% potash as sulfate. 2.89% potash as carbonate, 6.50% total potash.

*No. 75-110-1088 Chlorine .15% equivalent to .20% potash, .95% potash as sulfate, 4.45% potash as carbonate, 6.26% total potash.

*No. 115 Chlorine .62% equivalent to .82% potash, 1.82% potash as sulfate, 2.94% potash as carbonate, 6.36% total potash.

*No. 122 Chlorine .56% equivalent to .74% potash, 2.99% potash as sulfate, 1.97% potash as carbonate, 6.42% total potash.

*No. 605-1043 Chlorine 5.08% equivalent to 6.74% potash, 3.36% potash as sulfate.
" 128 " .29% " " .38% " 5.53% " " "
" 159 " .73% " " .97% " 5.18% " " "
" 429 " .16% " " .20% " 6.17% " " "

**No. 309 No Chlorine, 2.62% potash as sulfate, 2.93% potash as carbonate, 6.08% total potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Parmenter & Polsey Fertilizer Co. (Concluded.)				
P. & P. A.A. Brand	W. Springfield	$28.94	711	10.36
" " "	Auburn		985	
P. & P. Potato Grower with 10% Potash	Adams	24.04	962	8.14
P. & P. Grain Grower	Adams	15.19	1021	9.57
R. T. Prentiss, Granby, Mass.				
R. T. Prentiss' Fertilizer for Potatoes and Vegetables	Holyoke	29.02	201	10.64
R. T. Prentiss' Fertilizer for Potatoes and Vegetables	Easthampton	29.10	1047	9.66
R. T. Prentiss' Fertilizer for Corn	Holyoke	25.88	176	13.01
R. T. Prentiss' Fertilizer for Corn	W. Springfield	27.15	748	11.39
" " " " "	Easthampton		1052	
R. T. Prentiss' Fertilizer for Top Dressing	Holyoke	32.71	195	9.23
R. T. Prentiss' Fertilizer for Top Dressing	Easthampton	31.07	1053	3.19
The Pulverized Manure Co., Chicago, Ill.				
Wizard Brand Shredded Cattle Manure	Taunton	7.94	235	7.74
Wizard Brand Pulverized Sheep Manure	Fall River	12.48	276	10.09
The Rogers Manufacturing Co., Rockfall, Ct.				
All Round Fertilizer	N. Westport	16.51	312	10.21
" " "	Worcester		801	
Complete Potato and Vegetable Fertilizer	N. Westport	21.11	357	10.10
" " " " "	Plainville		758	
" " " " "	Worcester		827	
" " " " "	Norwood		359	
High Grade Corn and Onion Manure	Fitchburg	26.79	799	7.52
" " " " " "	E. Longmeadow		939	
High Grade Fertilizer for Oats and Top Dressing	Deerfield	35.96	65	8.03
Fish and Potash	Sunderland	21.55	24	9.30
" " "	N. Westport		316	
" " "	Sunderland		329	
High Grade Soluble Tobacco and Potato Manure	Deerfield	29.56	64	7.33
" " " " " " "	W. Springfield		705	
" " " " " " "	Fitchburg		824	
High Grade Grass and Grain, Seeding Down	Plainville	33.22	757	7.92
" " " " " " "	Fitchburg		810	
High Grade Tobacco Grower	Hadley	28.59	1094	8.77
High Grade Tobacco Grower (Vegetable & Carbonate)	N. Amherst	27.65	1079	8.33
High Grade Soluble Tobacco Manure	Deerfield	34.94	70	7.10
" " " " "	E. Longmeadow		929	
" " " " "	Deerfield		1016	
The Rogers & Hubbard Co., Middletown, Ct.				
Hubbard's "Bone Base" Complete Phosphate	Westport	17.85	317	8.68
" " " " "	E. Milton		473	
Hubbard's "Bone Base" Potato Phosphate	Westport	21.98	322	10.34
Hubbard's "Bone Base" Potato Phosphate	E. Milton	22.06	471	10.20
Hubbard's "Bone Base" New Market Gar. Phosphate	Bedford	24.86	842	6.38
" " " " " " " "	W. Peabody		855	
" " " " " " " "	Feeding Hills		897	
" " " " " " " "	Longmeadow		1061	
Hubbard's "Bone Base" Soluble Corn and Gen. Crops	Millis	24.07	530	5.20
" " " " " " " " "	Lynn		618	
" " " " " " " " "	Hadley		743	
" " " " " " " " "	Longmeadow		1065	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.55	.88	1.22	.45	4.10	4.10	5.88	1.63	1.42	8.93	8.00	7.51	7.00	8.20	8.00
1.19	.45	.57	.28	2.49	2.46	5.08	1.70	.36	7.14	7.00	6.78	6.00	10.70	10.00
.10	.75	.35	.25	1.45	1.23	5.18	3.14	.86	9.18	8.00	8.32	7.00	2.61	2.00
3.03	.19	.08	.16	3.46	3.30	7.60	1.46	.56	9.62	9.00	9.06	8.00	10.78	10.00
2.86	.28	.10	.17	3.41	3.30	7.98	1.24	.38	9.60	9.00	9.22	8.00	10.91	10.00
2.28	.23	.17	.26	2.94	2.80	8.45	1.76	.33	10.54	10.00	10.21	10.00	7.83	8.00
2.54	.13	.16	.20	3.03	2.80	8.87	2.33	.28	11.48	10.00	11.20	10.00	8.19	8.00
4.51	.54	.21	.29	5.55	5.70	5.58	1.29	.51	7.38	7.00	6.87	6.00	8.98	8.00
4.29	.44	.20	.27	5.20	5.70	4.43	2.46	.79	7.68	7.00	6.89	6.00	8.43	8.00
—	.29	.36	.96	1.61	1.80	.43	.46	.15	1.04	1.00	.89	1.00	.95**	1.00
—	.44	.55	1.26	2.25	1.80	.78	.82	.22	1.82	—	1.60	1.00	2.36**	1.00
.73	.18	.55	.41	1.87	1.65	3.63	4.41	1.91	9.95	10.00	8.04	8.00	2.60	2.00
.35	.56	.62	.39	2.42	2.25	5.48	2.90	1.78	10.16	10.00	8.38	8.00	5.14	5.00
1.24	.65	1.24	.70	3.83	3.60	2.45	4.32	1.78	8.55	6.00	6.77	6.00	7.62	7.00
3.76	.86	1.05	.47	6.14	6.30	1.00	6.94	1.96	9.90	9.00	7.94	7.00	8.57	7.50
1.29	.56	.96	.74	3.55	3.25	2.70	3.42	—	6.12	6.00	6.12	4.00	4.15	3.75
1.01	1.05	1.00	.51	3.57	3.50	.45	7.11	2.22	9.78	9.00	7.56	7.00	9.30*	8.75
.23	—	2.16	.80	3.19	3.00	trace	9.18	10.18	19.36	16.00	9.18	—	11.53	12.50
1.39	1.05	1.41	1.09	4.94	5.00	.35	4.63	.56	5.54	4.00	4.98	3.00	6.16*	5.50
.83	.75	1.87	1.61	5.06	5.00	.10	3.43	.48	4.01	4.00	3.53	3.00	5.85*	5.50
1.30	1.42	1.23	.66	5.11	5.00	.43	6.23	1.34	8.50	7.00	6.66	5.00	10.06*	10.50
.41	.17	.64	.38	1.60	1.50	4.33	2.90	1.60	8.83	8.00	7.23	7.00	6.02	5.00
.92	.23	.72	32	2.19	2.00	6.45	2.92	1.81	11.18	10.00	9.37	9.00	6.16	5.00
.91	.22	.67	39	2.19	2.00	6.63	2.95	1.32	10.90	10.00	9.58	9.00	6.28	5.00
.35	.31	.77	.41	2.34	2.00	3.63	3.32	1.78	8.73	7.00	6.95	6.00	11.47	10.00
1.31	.33	.63	.35	2.62	2.50	2.18	5.05	1.91	9.14	8.00	7.23	6.00	9.42	8.00

*No. 64–705–824 Chlorine .95% equivalent to 1.27% potash, 8.03% potash as sulfate.
" 1094 " .77% " " 1.01% " 5.15% " " "
" 1079 " 1.21% " " 1.61% " 4.24% " " " total potash 6.09%
" 70–929–1016 " .99% " " 1.30% " 8.76% " " "
**Potash figured as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
The Rogers & Hubbard Co. (Concluded).				
Hubbard's "Bone Base" Soluble Potato Manure	Bradstreet		133	
" " " " " "	Westport		318	
" " " " " "	Hadley	$31.47	755	11.57
" " " " " "	W. Peabody		856	
" " " " " "	Longmeadow		1063	
Hubbard's "Bone Base" Soluble Tobacco Manure	Westport		253	
" " " " " "	Feeding Hills	36.22	398	9.66
" " " " " "	Longmeadow		1063	
Hubbard's "Bone Base" Fruit or Grass & Gr. Fert.	E. Milton	30.92	468	6.84
" " " " " " " " "	Chelmsford		627	
Hubbard's "Bone Base" Oats and Top Dressing	Westport		314	
" " " " " " "	Lynn	43.60	634	3.42
" " " " " " "	Hadley		752	
" " " " " " "	Longmeadow		1057	
Ross Brothers Co., 88 Front St., Worcester, Mass.				
High Grade Potato Fertilizer	Worcester	27.91	641	8.87
Potato and Vegetable Fertilizer	Worcester	20.66	795	12.11
Corn, Grass and Grain Fertilizer	Worcester	24.94	820	8.45
Lawn Fertilizer	Whitinsville	22.91	1115	5.91
Sanderson Fertilizer & Chemical Co., New Haven, Ct.				
Sanderson's Formula "A"	Sunderland		54	
" " "	N. Amherst		133	
" " "	Sunderland		167	
" " "	Sunderland	24.85	168	10.65
" " "	Dighton		283	
" " "	Sunderland		331	
" " "	Southwick		934	
Sanderson's Formula "B"	Sunderland		13	
" " "	Sunderland		336	
" " "	Sunderland	26.23	422	3.16
" " "	Whately		609	
" " "	Southwick		942	
Sanderson's Top Dressing for Grass and Grain	Sunderland		53	
" " " " " " "	Sunderland		331	
" " " " " " "	Sunderland	23.36	334	10.17
" " " " " " "	Whately		608	
" " " " " " "	Greenfield		977	
Sanderson's Complete Tobacco Grower	Sunderland		17	
" " " "	Sunderland		52	
" " " "	Bradstreet	23.27	67	3.13
" " " "	Sunderland		155	
" " " "	Southwick		941	
Sanderson's Complete Tobacco Grower	Bradstreet	26.81	65	3.13
Sanderson's Potato Manure	Great Barrington	20.03	1030	13.15
Sanderson's Special with 10% Potash	N. Amherst		127	
" " " " "	Goshen		243	
" " " " "	Feeding Hills	24.51	363	8.86
" " " " "	Gt. Barrington		1029	
Sanderson's Corn Superphosphate	Gt. Barrington	18.72	1031	15.41
" " "	Southwick		1042	
Sanderson's Atlantic Coast Bone, Fish and Potash	Dighton	16.51	206	21.66

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.				Total.			Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
2.53	.53	1.32	.66	5.04	5.00	1.60	6.06	3.26	10.92	10.00	7.66	7.00	5.85*	5.00
2.28	.78	1.55	.72	5.33	5.00	1.38	6.05	3.29	10.72	10.00	7.43	7.00	9.44*	10.00
.42	.28	1.15	.84	2.69	2.20	.15	8.73	7.68	16.56	16.00	8.88	6.50	12.60	12.00
8.16	—	.49	.17	8.83	8.50	—	5.82	2.62	8.44	8.00	5.82	4.50	9.89	8.00
1.00	.37	1.09	.48	2.94	2.88	4.15	3.99	1.50	9.64	8.50	8.14	8.00	10.35*	10.00
.63	.48	.32	.19	1.62	1.65	4.43	3.84	1.58	9.85	8.50	8.27	8.00	5.56	5.00
2.26	.12	.36	.22	2.96	2.88	6.28	2.17	.66	9.11	10.50	8.45	8.00	7.58*	8.00
2.21	.18	.23	.51	3.13	2.00	3.13	4.45	1.38	8.96	10.00	7.58	6.00	6.10	4.00
2.16	.28	.64	.39	3.47	3.33	4.08	3.12	2.47	9.67	9.00	7.20	6.00	6.57	6.00
1.49	.24	1.03	.66	3.42	3.33	3.70	3.81	2.47	9.98	10.00	7.51	6.00	6.40*	6.00
2.12	.38	.76	.38	3.64	4.00	4.08	2.92	2.34	9.34	7.00	7.00	7.00	10.15	7.00
.17	.49	2.69	1.65	5.00	4.50	.85	3.53	.51	4.90	4.00	4.38	3.00	5.35*	5.50
.65	.03	2.01	1.94	4.63	4.50	1.20	3.60	.38	5.18	4.00	4.80	3.00	5.30*	5.50
.62	.27	.69	.58	2.16	1.67	3.20	2.78	2.04	8.02	8.00	5.98	5.00	7.31	6.00
1.12	.33	.71	.46	2.62	2.47	3.28	2.59	2.65	8.52	8.00	5.87	5.00	10.62	10.00
1.10	.03	.57	.45	2.15	1.67	1.28	5.41	1.91	8.60	9.00	6.69	7.00	3.37	2.00
.45	.31	.71	.70	2.17	1.67	1.18	3.88	2.14	7.20	6.00	5.06	4.00	4.07	4.00

No. 188–318–755–856–1068 Chlorine .57% equivalent to .76% potash, 5.09% potash as sulfate.
" 253–898–1063 " .77% " " 1.02% " 8.42% " " "
" 841 " 4.40% " " 5.83% " 4.52% " " "
" 820 " 2.99% " " 3.96% " 3.62% " " "
" 12–386–422–609–942 " .42% " " .56% " 5.84% " " "
" 17–52–67–155–941 " .17% " " .24% " 5.11% " " "
" 85 " .49% " " .65% " 4.65% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
"Swift-Sure" Superphosphate for General Use	Sunderland	$27.38	10	9.55
	Hatfield		130	
	Hatfield		132	
	W. Springfield		707	
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.				
Swift's Lowell Lawn Dressing	Springfield	26.07	708	5.53
	Upton		729	
	Ayer		731	
	Brockton		847	
Swift's Lowell Dissolved Bone and Potash	N. Westport	13.38	361	10.10
	Millis		638	
	Milford		725	
Swift's Lowell Seeding Down Fertilizer	Ayer	22.51	722	9.73
Swift's Lowell Corn and Vegetable	Beverly	25.42	643	8.99
Swift's Lowell Cereal Fertilizer	Lowell	11.38	640	7.72
	Southwick		904	
Swift's Lowell Empress Brand	Springfield	19.72	712	7.59
	Milford		728	
	Webster		961	
Swift's Lowell Bone Fertilizer for Corn and Grain	Somerset	17.41	311	9.36
	Millis		531	
	Springfield		717	
	Holyoke		868	
	Webster		947	
	E. Wilbraham		1067	
Swift's Lowell Potato Manure	Fall River	18.30	277	8.65
	Beverly		641	
	Millis		647	
	Springfield		714	
	Barre Plains		809	
	Southwick		927	
	Webster		945	
Swift's Lowell Animal Brand	Sunderland	20.57	23	10.60
	Fall River		261	
	S. Amherst		445	
	Millis		557	
	Beverly		644	
Swift's Lowell Potato Phosphate	Fall River	22.18	292	10.54
	Somerset		321	
	Raynham		489	
Swift's Lowell Superior Fert. with 10 percent Potash	Fall River	28.91	278	9.99
	Raynham		490	
Swift's Lowell Superior Fert. with 10 percent Potash	Seekonk	28.13	325	8.46
Swift's Lowell Special Grass for Top Dress. & Lawns	Chelmsford	27.25	612	8.88
Swift's Lowell Special Potato Fertilizer	Raynham	23.94	543	3.12
	Milford		728	
	E. Wilbraham		1059	
Swift's Lowell Sterling Phosphate	Southbridge	15.93	960	8.59
Swift's Lowell Market Garden Manure	Raynham	23.10	463	9.06

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs. — As Nitrates and Ammoniates.	Nitrogen in 100 lbs. — Water Soluble Organic.	Nitrogen in 100 lbs. — Active Water Insoluble Organic.	Nitrogen in 100 lbs. — Inactive Water Insoluble Organic.	Nitrogen — Total. Found.	Nitrogen — Total. Guaranteed.	Phosphoric Acid in 100 lbs. — Water Soluble.	Phosphoric Acid — Reverted.	Phosphoric Acid — Insoluble.	Phosphoric Acid — Total. Found.	Phosphoric Acid — Total. Guaranteed.	Phosphoric Acid — Available. Found.	Phosphoric Acid — Available. Guaranteed.	Potash (K_2O) in 100 lbs. — Found.	Potash (K_2O) in 100 lbs. — Guaranteed.
1.12	1.17	.75	.31	3.35	2.88	8.68	2.74	1.42	12.84	13.00	11.42	9.00	5.02*	4.50
3.67	.32	.06	.05	4.10	4.00	6.85	1.47	.10	8.42	8.00	8.32	7.00	5.81	6.00
.48	.74	.41	.30	1.93	1.64	6.60	3.10	2.16	11.86	10.00	9.70	9.00	2.31	2.00
1.30	.54	.52	.30	2.66	2.46	6.35	2.48	.33	9.16	9.00	8.83	8.00	6.14	6.00
1.56	.91	.53	.32	3.22	3.23	6.63	1.66	.79	9.08	9.00	8.29	8.00	7.46	7.00
.08	.50	.30	.21	1.09	.82	5.20	2.22	.90	8.32	8.00	7.42	7.00	1.22	1.00
.11	.69	.30	.23	1.33	1.34	4.70	3.06	.58	8.34	8.00	7.76	7.00	2.18	2.00
.30	.33	.36	.31	1.30	1.64	6.35	1.72	1.91	9.98	9.00	8.07	8.00	3.37	3.00
.45	.68	.45	.32	1.90	1.64	5.20	2.96	1.02	9.18	8.00	8.16	7.00	4.55	4.00
1.08	.76	.40	.29	2.53	2.46	6.45	2.36	.79	9.60	9.00	8.81	8.00	4.09	4.00
1.08	.54	.56	.31	2.49	2.46	6.90	1.96	.40	9.26	9.00	8.86	8.00	6.20	6.00
1.05	1.05	.97	.50	3.57	3.69	5.70	2.11	.71	8.52	8.00	7.81	7.00	10.31	10.00
1.55	.79	.77	.41	3.52	3.69	5.55	1.47	1.02	8.04	8.00	7.02	7.00	10.51	10.00
1.59	1.19	.82	.42	4.02	4.10	5.55	2.31	.92	8.78	8.00	7.86	7.00	6.53	6.00
1.17	.52	.68	.23	2.60	2.46	4.88	1.73	.61	7.22	7.00	6.61	6.00	10.16	10.00
.10	.50	.26	.19	1.05	.82	5.80	3.32	1.70	10.82	9.	9.12	8.00	4.09	4.00
1.57	1.40	.71	.42	4.10	4.10	6.03	2.26	.92	9.21	8.00	8.29	7.00	8.71	8.00

*No. 10–180–182–707 Chlorine .48% equivalent to .64% potash, 4.38% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Wm. Thomson & Sons, Ltd., Clovenfords, Scotland.				
Thomson's Vine, Plant and Vegetable Manure	Boston	$32.55	355	8.34
Thomson's Special Chrysanthemum Manure	Boston	31.72	1107	2.52
20th Century Specialty Co., Boston, Mass.				
The "Scientific" 12 L. No. 1	Boston	9.54	850	2.16
The "Scientific" 12 L. No. 2	Boston	15.70	851	3.42
The "Scientific" 12 L. No. 3	Boston	20.26	852	3.62
Whitman & Pratt Rendering Co., Lowell, Mass.				
Corn Success	Billerica	19.49	621	7.80
All Crop	Billerica	23.66	622	9.33
Potato Manure	Billerica	24.92	626	7.33
Vegetable Grower / " "	Billerica / Chelmsford	28.52	624 / 632	11.25
Potash Special / " " / " "	Taunton / Chelmsford / W. Springfield	29.53	238 / 630 / 911	6.44
The Wilcox Fertilizer Co., Mystic, Ct.				
Wilcox Potato, Onion and Vegetable Phosphate / " " " " " " / " " " " " " / " " " " " "	Amherst / Fall River / Marblehead / Monson	28.56	47 / 280 / 500 / 786	11.13
Wilcox Potato, Onion and Vegetable Phosphate	New Bedford	28.10	184	12.56
Wilcox Grass Fertilizer / " " "	Fall River / Seekonk	27.98	269 / 323	8.48
Wilcox High Grade Tobacco Special / " " " " "	Amherst / Hadley	29.80	48 / 602	5.86
Wilcox 4-8-10 Fertilizer	Southampton	30.44	1086	10.75
Wilcox Complete Bone Superphosphate / " " " "	Fall River / Marblehead	20.08	268 / 499	15.98
Wilcox High Grade Fish and Potash	Dighton	25.44	245	19.21
Wilcox Potato Fertilizer / " " " / " " "	Dighton / Fall River / Monson	20.83	255 / 272 / 774	14.70
Wilcox Fish and Potash / " " " "	Amherst / Hadley	20.26	43 / 603	19.53
Wilcox Fish and Potash	New Bedford	20.12	192	19.68
Wilcox Fish and Potash	Fall River	20.12	293	18.64
Wilcox Corn Special / " " " / " " "	Amherst / Dighton / Fall River	23.50	39 / 244 / 265	12.94
A. H. Wood & Co., Framingham, Mass.				
Wood's B. B. Fertilizer	Framingham	22.67	944	10.58
Wood's S. P. Fertilizer / " " "	Framingham / Framingham	34.48	667 / 954	6.86
Wood's 777 Fertilizer / " " "	Framingham / Framingham	36.27	649 / 949	6.79

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.60	.88	1.32	.55	4.35	3.50	5.65	5.98	1.07	12.70	12.00	11.63	8.00	7.29*	7.00
4.43	.29	.47	.25	5.44	4.00	4.30	4.99	4.08	13.37	12.00	9.29	6.50	4.44	4.50
1.08	—	.05	.05	1.18	1.00	1.53	1.34	.22	3.09	2.00	2.87	2.00	3.03*	3.00
2.47	—	.05	.04	2.47	2.00	2.80	1.52	—	4.32	3.00	4.32	3.00	4.01*	4.00
3.29	.01	.07	.06	3.43	3.00	3.13	1.95	.15	5.23	4.00	5.08	4.00	4.61*	5.00
.21	.58	.76	.48	2.03	1.64	1.40	8.07	3.11	12.58	10.00	9.47	8.00	3.43	3.00
.56	.64	.99	.79	2.98	2.46	2.45	7.19	1.30	10.94	11.00	9.64	9.00	4.86	4.00
.86	.21	.95	.81	2.83	2.46	1.60	9.69	.96	12.25	9.00	11.29	7.00	5.91	5.00
1.40	.43	1.06	.84	3.73	3.29	4.25	5.88	1.10	11.23	10.00	10.13	8.00	7.15	7.00
1.29	.26	.79	.88	3.22	2.83	2.28	7.63	.61	10.52	8.00	9.91	6.00	11.24	10.00
1.34	.22	1.28	.73	3.57	3.30	7.60	2.66	.36	10.62	9.00	10.26	8.00	7.54*	7.00
1.32	.24	1.20	.82	3.58	3.30	6.95	2.69	1.20	10.84	9.00	9.64	8.00	7.36*	7.00
2.23	.54	1.05	67	4.49	4.12	3.28	4.98	1.20	9.46	7.00	8.26	6.00	5.43	5.00
1.14	.34	1.36	.92	3.76	3.30	trace	9.42	1.10	10.52	7.00	9.42	5.00	7.89*	7.00
2.50	.14	.68	.48	3.80	3.30	7.40	1.74	.38	9.52	9 00	9.14	8.00	10.12*	10.00
.80	.18	.80	.58	2.36	2.05	3.23	5.89	1.78	10.90	9.00	9.12	8.00	3.74	3.00
.36	.60	1.78	1.17	3.91	3.30	4.28	2.58	.74	7.60	7.00	6.86	6.00	5.35	5.00
.81	.14	.78	.71	2.44	2.05	1.73	6.16	2.34	10.23	7.00	7.94	6.00	5.29	4.50
.33	.61	1.22	.78	2.94	2.46	1.83	4.57	1.66	8.06	6.00	6.40	5.00	3.86	3.00
.38	.58	1.20	.87	3.03	2.46	2.23	3.34	2.42	7.99	6.00	5.57	5.00	3.71	3.00
.37	.59	1.30	.74	3.00	2.46	2.45	3.19	2.30	7.94	6.00	5.64	5.00	3.80	3.00
.88	.31	1.01	.64	2.84	2.46	3.55	4.80	2.37	10.72	9.00	8.35	8.00	6.07	5.00
1.42	.23	.56	.47	2.68	2.50	4.95	4.80	.66	10.41	10.00	9.75	7.00	5.45	5.00
2.89	.30	.60	.55	4.34	4.00	3.93	3.39	.28	7.60	8.00	7.32	6.00	12.79*	12.00
6.34	—	.32	.31	6.97	7.00	4.50	3.29	.33	8.12	8.00	7.79	7.00	7.23	7.00

*No.	355	Chlorine	4.26%	equivalent to	5.66%	potash,	1.63% potash as sulfate.
"	850	"	.62%	" "	.83%	"	2.25% " " "
"	851	"	1.52%	" "	2.02%	"	1.99% " " "
"	852	"	1.54%	" "	2.05%	"	2.56% " " "
"	47-280-500-786	"	5.31%	" "	6.81%	"	.73% " " "
"	184	"	4.70%	" "	6.24%	"	1.12% " " "
"	48-602	"	.72%	" "	.95%	"	6.94% " " "
"	1086	"	5.93%	" "	7.86%	"	2.26% " " "
"	667-954	"	1.36%	" "	1.81%	"	10.98% " " "

Fertilizers Furnishing Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
PHOSPHATE AND POTASH.				
American Agricultural Chemical Co., Boston, Mass.				
Grass and Oats Fertilizer	W. Sterling	$12.37	877	11.56
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Tobacco Ash Elements	N. Hadley	21.97	137	9.56
Bowker's Tobacco Ash Elements	Hatfield	23.05	220	6.54
" " " "	Northampton		450	
" " " "	Southwick		1044	
Coe-Mortimer Co., New York City.				
E. Frank Coe's Famous Prize Brand Grass and Grain	S. Williamstown	10.89	974	8.92
Lister's Agricultural Chemical Works, Newark, N. J.				
Lister's Grass and Grain Fertilizer	Fall River	10.59	353	11.08
" " " " "	Hadley		512	
Lister's Grass and Grain Fertilizer	Williamstown	10.62	975	10.85
Olds & Whipple, Hartford, Ct.				
Vegetable Potash and Bone Phosphate	Hatfield	33.73	173	3.78
WOOD ASHES.				
Bowker Fertilizer Co., Boston, Mass.				
Pure Unleached Canada Hardwood Ashes	Fall River	**11.58	289	5.92
Pure Unleached Canada Hardwood Ashes	Amesbury	** 7.84	503	18.96
John Joynt, Lucknow, Ontario, Canada.				
Pure Hardwood Ashes	Sunderland	**11.51	7	18.57
Pure Hardwood Ashes	Sunderland	** 9.42	16	22.58
Pure Hardwood Ashes	N. Hadley	** 9.03	109	12.55
Pure Hardwood Ashes	N. Hadley	**10.09	296	12.44
Pure Hardwood Ashes	Sunderland	**11.61	383	12.17
Pure Hardwood Ashes	Sunderland	** 8.06	838	16.93
Pure Hardwood Ashes	Sunderland	** 8.60	1120	18.64

Fertilizers Furnishing Phosphoric Acid and Potash.

Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.		
			Total.		Available.				
Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Calcium Oxide (CaO) in 100 lbs.
8.20	2.56	1.38	12.14	12.00	10.76	11.00	2.81	2.00	—
1.44	5.35	1.86	8.65	9.00	6.79	6.00	15.20*	15.00	—
.85	5.92	2.09	8.86	9.00	6.77	6.00	14.92*	15.00	—
6.48	3.48	.68	10.64	11.00	9.96	10.00	2.37	2.00	—
7.36	2.31	.71	10.38	11.00	9.67	10.00	2.16	2.00	—
7.28	2.63	.68	10.59	11.00	9.91	10.00	2.00	2.00	—
.38	10.95	.28	11.61	—	11.33	12.00	16.18*	15.00	—
—	—	—	2.03	1.00	—	—	4.92	†2.00	28.61
—	—	—	1.20	1.00	—	—	3.44	†2.00	18.69
—	—	—	1.59	1.00	—	—	5.00	3.00	29.99
—	—	—	1.28	1.00	—	—	4.24	3.00	21.74
—	—	—	1.28	1.00	—	—	3.52	3.00	31.22
—	—	—	1.34	1.00	—	—	4.08	3.00	32.75
—	—	—	1.67	1.00	—	—	4.53	3.00	39.89
—	—	—	1.02	1.00	—	—	3.60	3.00	19.82
—	—	—	1.28	1.00	—	—	3.50	3.00	26.29

*No. 137 Chlorine 1.16% equivalent to 1.53% potash, 13.67% potash as sulfate.
" 220-450-1044 " .94% " " 1.26% " 13.66% " " "
" 173 " .77% " " 1.03% " .99% " " " 14.16 potash as carbonate.

**The potash in ashes is largely present as carbonate and has been valued at 8 cts. per pound.

The lime in ashes has been valued at the same price as for agricultural lime, namely .004 cts. per pound of actual calcium oxide.

†Total potash guaranteed 4.00%.

Fertilizers for Private Use, Officially Collected (Not Registered.)

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agricultural Chemical Co., Boston, Mass.				
[illegible] Formula	Fall River	$26.04	290	10.56
Read's [illegible] Mixture	Littleton	25.[illegible]	328	8.14
Berkshire Fertilizer Co., Bridgeport, Ct.				
[illegible] Grass Fertilizer	N. Hadley		118	
" "	N. Hadley	41.08	124	8.40
" "	N. Hadley		[illegible]	
Tobacco Special with Sulfate of Potash	N. Hadley	[illegible]	[illegible]	7.87
Fish and Potash	N. Hadley	[illegible]	759	5.18
A Special Mixture	N. Hadley	[illegible]	142	8.88
Mixture	Plainville	41.[illegible]	[illegible]	[illegible]
[illegible] Dust	Whately	[illegible]	[illegible]	4.[illegible]
W. W. Cary & Son, Lyonsville, Mass.				
Complete Fertilizer Home Mixture	Lyonsville	35 58	1188	7.67
The E. D. Chittenden Co., Bridgeport, Ct.				
Special Mixture	W. Springfield	35.97	424	6.21
Fisher Brothers, Philadelphia, Pa.				
[illegible] Dust	Hatfield	4 67	174	4.85
J. A. Macomber, Swansea, Mass.				
Potato Fertilizer Home Mixture	Swansea	30 28	1184	6.25
[illegible] Fertilizer Home Mixture	Swansea	27 47	1180	5.89
Mitchell Fertilizer Co., Tremley, N. J.				
[illegible] Special Fertilizer	[illegible]	28 58	820	9.84
National Fertilizer Co., Boston, Mass.				
[illegible] Special Formula	Sunderland	28 28	330	7.88
New England Fertilizer Co., Boston, Mass.				
[illegible] Special with 10% Potash	Natick	30 12	840	8.10
New Mineral Fertilizer Co., Boston, Mass.				
New Mineral Fertilizer	Boston	0 67	578	.02
Olds & Whipple, Hartford, Ct.				
Special Mixture	Whately	30 38	568	6.14
Warner's Special Mixture	Hatfield	28.71	868	8.88
Rogers & Hubbard Co., Middletown, Ct.				
Allen's Special Top Dressing	Longmeadow	38 68	1058	5.18
Prof. J. W. Sanborn, Pittsfield, N. H.				
Sanborn's Complete for Potatoes and Corn	Ashfield	29 34	1148	6 58
M. L. Shoemaker & Co., Philadelphia, Pa.				
Superphosphate for Potatoes	Conway	25 14	370	7.88
Stonemeal Fertilizer Co., Paterson, N. J.				
Stonemeal	Hatfield	1 75	870	1.08
Stonemeal [illegible]	Hatfield	[illegible]	871	.72
Stonemeal	Hatfield	[illegible]	1140*	1.08
Swift's Lowell Fertilizer Co., Boston, Mass.				
Special Mixture	Bedford	30 58	840	8.16
F. A. Thompson Co., Detroit, Mich.				
[illegible] Dust	Worcester	10 65	791	7.50
S. D. Woodruff & Sons, Orange, Ct.				
Home Mixture	Braintree	27 24	180	8.25
American Agricultural Chemical Co., Boston, Mass.				
Castor Pomace	Southwick	18 24	1088	10 24
Ground Bone	Sunderland	27 30	1110	5 44

*Sample contained 15.59% calcium oxide.

Fertilizers for Private Use, Officially Collected Not Registered.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash K_2O in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.74 1.38	.17 .34	1.33 .73	.46 .34	3.50 3.12	— 2.47	4.33 2.33	3.34 4.78	2.44 .74	10.33 3.40	— 7.00	7.34 4.33	— 3.00	3.33 3.30	— 10.00
7.33	—	.33	.11	7.33	3.00	.13	7.73	1.30	9.13	8.00	7.33	4.00	2.40	3.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2.34	.33	.53	.33	4.04	—	3.07	1.73	.33	3.33	—	3.43	—	3.11*	—
2.73	1.33	.34	.43	5.00	4.34	5.34	.33	.71	7.41	—	3.33	3.00	11.50*	11.00
—	.03	.24	.33	.35	—	—	—	—	1.00	—	—	—	.33	—
1.73 1.43	1.07 .33	.31 .33	.55 .47	4.13 3.40	— —	1.31 3.38	3.33 4.74	3.73 3.33	12.73 13.43	— —	3.37 7.31	— —	3.47 .34	— —
2.23	.37	1.13	.37	4.13	4.11	3.30	2.33	1.45	9.32	3.00	3.33	3.00	3.08	3.00
1.97	.03	.42	.13	2.61	2.47	6.45	3.73	1.43	11.88	11.00	10.10	10.00	7.87*	3.00
1.40	1.10	.50	.41	3.41	3.33	5.40	2.03	.33	3.14	3.00	7.43	7.00	11.33	10.00
.09	—	—	—	.09	—	—	—	—	.33	—	—	—	.10**	—
.50 .38	.33 .33	1.34 1.20	1.43 1.23	4.11 4.22	— —	— trace	2.33 2.43	— .32	3.33 3.42	— —	2.33 2.43	— —	3.72* 3.34*	— —
3.00	—	.57	.13	3.33	3.30	3.00	3.24	5.73	14.00	12.50	3.34	—	5.00	5.00
1.23	.43	1.33	.73	3.30	3.00	4.32	3.33	.33	3.53	10.00	3.31	7.00	3.53*	3.00
1.04	1.17	.54	.23	3.11	2.00	3.33	3.30	2.12	12.30	11.00	10.48	3.00	3.50	7.00
.25 .04 —	— — —	— — —	— — —	.33 .33 .15	— — —	— — —	.30 — .32	2.33 — 3.17	3.10 .48 2.48	— — —	— — .32	— — —	[illegible]** [illegible]** [illegible]**	— — —
2.33	1.13	.53	.42	4.33	3.00	3.33	3.32	.61	9.08	3.00	7.45	—	3.10	3.00
—	1.17	.11	.01	2.02	—	—	—	—	.32	—	—	—	3.47**	—
1.53	.21	.33	.37	3.34	3.23	3.00	3.33	1.34	3.50	—	3.33	3.00	3.13	3.00
— —	.31 —	1.71 —	2.04 —	4.33 2.31	4.53 —	— —	— —	— —	— 24.11†	— —	— —	— —	— —	— —

*No. 136 Chlorine .79 equivalent to 1.05% potash, 5.81% potash as sulfate.
" 142 " .69 " " " .92% " .73 " " " 4.33% potash as sulfate, 6.90% total potash.
*No. 597 Chlorine 2.18% equivalent to 2.90% potash, 20.41% potash as sulfate.
" 1077 " 1.19 " " " 1.78 " .46 " " "
" 1138 " .51 " " " .54 " 5.57 " " "
" 424 " .66 " " " .87 " 11.33 " " "
" 330 " .49 " " " .66 " 7.31 " " "
" 588 " .17 " " " .23 " 5.47 " " "
" 869 " .07 " " " .08 " 5.46 " " "
" 1146 " 4.87 " " " 6.47 " 2.18 " " "

**Potash figured as Sulfate. †Mechanical Analysis: Fine 42.83%, Coarse 57.17%.

Fertilizers for Private Use, Officially Collected (Not Registered.)

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen, Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Berkshire Fertilizer Co., Bridgeport, Ct.				
Sulfate of Ammonia	Plainville	$74.45	594	.78
Nitrate of Soda	N. Hadley	49.50	140	2.70
" " "	Whately		1078	
H. G. Sulfate of Potash	N. Hadley	51.28	139	.52
" " " "	N. Hadley		157	
" " " "	N. Hadley		299	
Double Sulfate of Potash	N. Hadley	28.52	152	4.31
Muriate of Potash	N. Hadley	43.72	131	.26
" " "	N. Hadley		149	
" " "	N. Hadley		341	
Acid Phosphate	N. Hadley	14.25	141	12.05
Tankage	N. Hadley	37.80	125	7.77
"	N. Hadley		151	
"	N. Hadley		328	
E. E. Bisbee, Boston, Mass.				
Imported Basic Slag Phosphate	Boston	13.72	1143	.38
Imported Basic Slag Phosphate	Boston	13.05	1144	.05
Bowker Fertilizer Co., Boston, Mass.				
Dissolved Bone Black	Amherst	14.99	1133	18.79
The E. D. Chittenden Co., Bridgeport, Ct.				
Nitrate of Soda	N. Amherst	51.08	50	1.93
Muriate of Potash	N. Amherst	44.23	58	.39
Coe-Mortimer Co., New York City.				
Sulfate of Ammonia	Amherst	67.25	1127	.77
Dried Blood	Amherst	43.77	1125	8.21
Low Grade Sulfate of Potash	Amherst	29.66	1129	1.66
Dry Ground Fish	Amherst	38.93	1122	7.52
Ground Bone	Amherst	29.60	1123	5.20
Dominion Iron & Steel Co., Sydney, Cape Breton Can.**				
Basic Slag Phosphate	Sydney, Canada	12.38	1117	.04
Humphreys Godwin Co., Memphis, Tenn.				
H. G. Cottonseed Meal	Sunderland	24.80	91	6.70
Jacksonville Oil Mill Co., Jacksonville, Ala.				
H. G. Cottonseed Meal	Sunderland	25.04	92	8.00
Memphis Cottonseed Products Co., Memphis, Tenn.				
"Selden" Cottonseed Meal	Bradstreet	26.40	744	9.58
Olds & Whipple, Hartford, Conn.				
Sulfate of Ammonia	Hadley	71.15	205	.47
Tankage	Hadley	33.01	202	9.00
Geo. B. Robinson, Jr., New York City.				
Robin Brand Cottonseed Meal	W. Hatfield	26.48	178	7.69
C. M. Shay, Groton, Ct.				
Nitrate of Soda	Millis	51.74	545	1.63
Muriate of Potash	Millis	45.15	544	.05
Acid Phosphate	Millis	13.44	551	12.61
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
Nitrate of Soda	Conway	51.02	966	1.88
Sulfate of Potash	Conway	51.20	964	.39
Muriate of Potash	Conway	45.15	971	.33
State Farm, Titicut, Mass.				
Dried Blood	Titicut	62.48	466	11.32
Ground Steamed Bone	Titicut	27.99	474	7.57
The Stroud Cotton Oil Co., Stroud, Okla.				
Cow Brand Cottonseed Meal	Hatfield	27.40	95	10.22

**The Cross Fertilizer Co., Sydney, Cape Breton, Canada, selling agents.

Fertilizers for Private Use, Officially Collected (Not Registered.)

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble. Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	R[illegible]	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
22.56	—	—	—	22.56	20.00	—	—	—	—	—	—	—	—	—
15.00	—	—	—	15.00	14.80	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	48.84	48.00
—	—	—	—	—	—	—	—	—	—	—	—	—	27.16	25.00
—	—	—	—	—	—	—	—	—	—	—	—	—	51.44	50.00
—	—	—	—	—	—	13.18	2.66	.64	16.48	—	15.84	—	—	—
.40	.47	4.95	1.63	7.45	7.40	—	—	—	15.08	10.00*	—	—	—	—
—	—	—	—	—	—	—	15.55	3.21	18.76	—	15.55†	—	—	—
—	—	—	—	—	—	—	15.32	1.98	17.30	—	15.32†	—	—	—
—	—	—	—	—	—	14.86	1.77	.51	17.14	—	16.63	—	—	—
15.48	—	—	—	15.48	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	52.04	—
20.38	—	—	—	20.38	—	—	—	—	—	—	—	—	—	—
—	5.26	2.34	1.25	8.85	—	—	—	—	8.05	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	28.25	—
—	.77	4.45	1.50	6.72	—	—	5.98	11.44	17.42	—	5.98	—	—	—
—	.28	1.69	.69	2.66	2.16	—	8.47	16.98	25.45	20.70	8.47*	—	—	—
—	—	—	—	—	—	—	15.04	.88	15.92	—	15.04†	—	—	—
—	—	—	—	6.20	—	—	—	—	—	—	—	—	—	—
—	—	—	—	6.26	6.50	—	—	—	—	—	—	—	—	—
—	—	—	—	6.60	6.56	—	—	—	—	—	—	—	—	—
21.56	—	—	—	21.56	20.56	—	—	—	—	—	—	—	—	—
.38	1.25	3.29	2.04	6.96	7.40	—	—	—	11.38	10.00*	—	—	—	—
—	—	—	—	6.62	6.50	—	—	—	—	—	—	—	—	—
15.68	—	—	—	15.68	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	53.12	—
—	—	—	—	—	—	12.08	3.20	.02	15.30	—	15.28	—	—	—
15.46	—	—	—	15.46	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	48.76	—
—	—	—	—	—	—	—	—	—	—	—	—	—	53.12	—
.15	.48	9.99	3.51	14.13	—	—	—	—	.52	—	—	—	—	—
—	.38	.43	.33	1.14	—	—	—	—	30.90*	—	—	—	—	—
—	—	—	—	6.85	6.50	—	—	—	—	—	—	—	—	—

*No. 125-151-328 Mechanical Analysis: Fine 65.43%, Coarse 34.57%.
" 1123 " " " 81.33% " 18.67%.
" 202 " " " 62.19% " 37.81%.
" 474 " " " 73.59% " 26.41%.

†Available Phosphoric by Wagner method.

NOTE. No. 1117 contained 42.13% calcium oxide of which 13.00% was in the more active form

Ground Bone.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.
American Agricultural Chemical Co., Boston, Mass.				
Fine Ground Bone	W. Springfield	$27.97	427	6.34
" " "	Ipswich		546	
" " "	E. L'meadow		938	
Farquhar's Pure Ground Bone	Boston	23.00	345	4.78
Armour Fertilizer Works, Baltimore, Md.				
Bone Meal	Amherst	27.02	34	9.66
Beach Soap Co., Lawrence, Mass.				
Beach's Fertilizer Bone	Lawrence	27.80	566	4.41
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Fresh Ground Bone	Dighton	25.88	257	7.69
" " " "	Northampton		454	
" " " "	Bridgewater		563	
" " " "	Springfield		767	
Bowker's Flour of Bone	Boston	28.76	350	6.77
Buffalo Fertilizer Co., Buffalo, N. Y.				
Bone Meal	Littleton	27.91	1004	7.01
John C. Dow Co., Boston, Mass.				
Dow's Pure Ground Bone	Boston	26.22	369	6.11
Thomas Hersom & Co., New Bedford, Mass.				
Pure Bone Meal	New Bedford	29.79	207	3.74
Home Soap Co., Worcester, Mass.				
Pure Ground Bone	Northboro	29.38	990	4.00
" " "	Millbury		999	
Geo. E. Marsh Co., Lynn, Mass.				
Marsh's Pure Ground Bone	Concord	29.55	478	4.65
" " " "	Framingham		946	
D. M. Moulton, Monson, Mass.				
Ground Bone	Man'f't'r's Sample	26.73	1100	8.24
National Fertilizer Co., Boston, Mass.				
Chittenden's Pure Ground Bone	Leominster	26.85	738	4.39
Nitrate Agencies Co., New York City.				
Ground Bone	Fitchburg	27.27	800	8.75
Olds & Whipple, Hartford, Ct.				
Pure Bone Meal	Sunderland	29.93	1083	5.69
Rogers Mfg. Co., Rockfall, Ct.				
Pure Knuckle Bone Flour	Greenfield	32.52	973	9.98
Pure Fine Ground Bone	Sunderland	34.00	41	12.33
Rogers & Hubbard Co., Middletown, Ct.				
Hubbard's Pure Raw Knuckle Bone Flour	E. Milton	33.30	475	9.38
Hubbard's Strictly Pure Fine Bone	Milford	28.23	733	7.23
N. Roy & Son, South Attleboro, Mass.				
Pure Ground Bone	Man'f't'r's Sample	26.90	83	3.52
Pure Ground Bone	S. Attleboro	28.60	654	6.61
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
Swift-Sure Bone Meal	Sunderland	36.75	3	3.75
" " " "	Sunderland		333	
Springfield Rendering Co., Springfield, Mass.				
Ground Steamed Bone	N. Amherst	29.33	71	3.78
T. L. Stetson, Randolph, Mass.				
Pure Ground Bone	Man'f't's Sample	28.82	522	8.59
" " "	Brockton		843	

Ground Bone.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
—	.37	1.55	.63	2.55	2.47	—	—	—	24.29	22.88	—	—	74.19	25.81
—	.69	1.46	.77	2.92	2.47	—	—	—	23.43	22.80	—	—	59.89	40.11
—	.73	1.39	.57	2.69	2.47	—	—	—	22.66	22.50	—	—	69.94	30.06
.30	.94	.98	.97	3.19	2.67	—	—	—	22.88	20.00	—	—	45.66	54.34
—	.53	1.30	.59	2.47	2.47	—	—	—	22.96	22.88	—	—	56.16	43.84
.13	.93	1.12	.48	2.66	2.47	—	—	—	24.08	22.88	—	—	86.36	13.64
—	.64	1.51	.75	2.90	2.90	—	—	—	23.70	22.00	—	—	55.74	44.26
—	.70	.98	.57	2.25	2.00	—	—	—	24.48	24.00	—	—	54.98	45.02
—	1.04	.62	.56	2.22	2.00	—	—	—	27.70	24.00	—	—	82.31	17.69
—	.72	1.12	.63	2.47	2.00	—	—	—	28.18	28.00	—	—	46.82	53.18
.33	.64	1.28	.86	3.11	2.46	—	—	—	25.36	28.00	—	—	49.08	50.92
—	.44	2.61	1.23	4.28	4.26	—	—	—	19.26	18.00	—	—	7.70	92.30
—	.49	1.39	.62	2.50	2.47	—	—	—	22.96	22.88	—	—	76.34	23.66
—	.63	1.68	.66	2.97	2.47	—	—	—	22.52	22.88	—	—	56.05	43.95
—	.44	1.99	.90	3.33	2.50	—	—	—	25.30	22.00	—	—	43.09	56.91
—	.02	3.22	.68	3.92	3.80	—	—	—	25.13	24.00	—	—	56.01	43.99
—	.34	2.51	.69	3.54	3.00	—	—	—	26.40	22.00	—	—	89.49	10.51
—	.14	3.03	.72	3.89	3.82	—	—	—	25.28	24.70	—	—	69.75	30.25
—	.28	2.43	1.12	3.83	2.85	—	—	—	20.74	22.00	—	—	43.30	56.70
—	—	—	—	2.64	2.64	—	—	—	25.72	25.72	—	—	41.89	58.11
.59	.50	1.22	.85	3.16	2.64	—	—	—	24.82	25.72	—	—	34.87	65.13
.14	1.36	2.79	.70	5.49	4.53	—	—	—	22.84	20.00	—	—	64.33	35.62
—	.50	1.02	.78	2.30	2.47	—	—	—	26.94	23.00	—	—	78.66	21.34
—	.27	3.23	.81	4.31	4.20	—	—	—	21.64	20.66	—	—	13.29	86.71

Ground Bone, Dissolved Bone and Tankage.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.
Swift's Lowell Fertilizer Co., Boston, Mass.				
Swift's Lowell Ground Bone	Taunton		226	
" " " "	Fall River		254	
" " " "	Fall River	$29.64	270	3.97
" " " "	Springfield		701	
" " " "	Worcester		807	
Whitman & Pratt Rendering Co., Lowell, Mass.				
Ground Bone	N. Chelmsford	23.61	953	7.64
Wilcox Fertilizer Co., Mystic, Ct.				
Wilcox Pure Ground Bone	New Bedford	23.69	190	4.39
Sanford Winter Co., Brockton, Mass.				
Pure Ground Bone	Brockton	33.35	393	8.95
Worcester Rendering Co., Auburn, Mass.				
Ground Bone	Worcester	30.23	661	5.38
DISSOLVED BONE.				
W. H. Abbott, Holyoke, Mass.				
Abbott's Animal Brand Fertilizer	Sunderland	27.63	15	11.42
" " " "	Holyoke		863	
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Dissolved Bone	Taunton	20.00	464	9.26
" " "	Southbridge		889	
Bowker's Dissolved Bone	Amherst	20.70	1132	12.52
Mapes' Formula and Peruvian Guano Co., New York.				
Mapes' Dissolved Bone	Conway	24.75	963	5.98
TANKAGE.				
American Agricultural Chemical Co., Boston, Mass.				
Ground Tankage	Amherst	33.94	33	6.31
" "	E. L'meadow		940	
Ground Tankage	Boston	37.30	366	5.70
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Fine Ground Bone Tankage	Marblehead	31.52	495	13.21
" " " " "	Northampton		515	
Coe-Mortimer Co., New York City.				
E. Frank Coe's Ground Animal Tankage	Hadley	36.73	1039	6.50
E. Frank Coe's Ground Animal Tankage	Amherst	36.53	1124	5.75
E. Frank Coe's Ground Animal Tankage	Marstons Mills	36.52	1142	3.20
Thomas Hersom & Co., New Bedford, Mass.				
Meat and Bone	New Bedford	30.93	136	7.64
Geo. E. Marsh Co., Lynn, Mass.				
Marsh's Ground Tankage	Concord	27.64	479	7.56
Nitrate Agencies Co., New York City.				
Tankage	Titicut	31.63	397	7.67
Tankage	Framingham	26.95	666	10.63
Springfield Rendering Co., Springfield, Mass.				
Ground Tankage	Amherst		59	
" "	N. Amherst	35.03	73	7.10
" "	N. Hadley		160	
" "	N. Hadley		297	
Ground Tankage	Amherst	34.41	1119	6.91
Swift's Lowell Fertilizer Co., Boston, Mass.				
Tankage	Fall River		302	
"	Concord	31.81	676	7.64
"	Springfield		713	

Ground Bone, Dissolved Bone and Tankage.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
.10	.90	.80	.66	2.46	2.46	—	—	—	26.50	23.00	—	—	80.68	19.32
.45	.79	1.17	.76	3.17	2.47	—	—	—	23.90	25.00	—	—	48.12	51.88
—	.53	1.36	1.08	2.97	1.64	—	—	—	24.32	24.00	—	—	57.23	42.77
.18	2.07	2.20	1.16	5.61	3.25	—	—	—	19.29	24.15	—	—	46.98	53.02
.13	.63	1.29	1.27	3.32	2.46	—	—	—	24.32	23.00	—	—	63.87	36.13
.63	.84	1.16	1.15	3.78	3.50	1.38	13.67	3.50	18.55	15.00	15.05	12.00	—	—
.16	.67	.36	.35	1.54	1.64	9.93	3.69	3.32	16.94	14.00	13.62	12.00	—	—
—	—	—	—	2.58	1.64	7.59	2.47	5.23	15.29	14.00	10.06	12.00	—	—
.35	.65	.78	.74	2.52	2.06	3.93	11.68	1.54	17.35	—	15.81	12.00	—	—
.26	2.62	1.64	1.24	5.66	4.94	—	—	—	18.68	13.73	—	—	60.75	39.25
.19	.56	4.43	2.15	7.33	7.41	—	—	—	14.04	9.15	—	—	75.26	24.74
.40	1.36	2.74	1.28	5.78	4.94	—	—	—	16.08	13.73	—	—	46.85	53.15
.20	.82	4.34	1.67	7.53	7.40	—	—	—	13.30	9.15	—	—	65.69	34.31
—	1.04	4.30	2.44	7.73	7.40	—	—	—	12.09	9.15	—	—	63.60	36.40
—	1.37	4.26	2.16	7.79	7.40	—	—	—	12.45	9.15	—	—	59.27	40.73
.13	.50	2.65	1.31	5.09	4.00	—	—	—	16.28	17.00	—	—	74.90	25.10
.25	.43	2.37	2.23	5.28	5.00	—	—	—	12.68	12.00	—	—	53.24	46.76
.36	1.29	2.37	1.54	5.56	6.37	—	—	—	16.97	14.00	—	—	50.00	50.00
.54	.89	2.70	1.92	6.05	5.35	—	—	—	8.62	16.00	—	—	43.63	51.37
.27	3.96	2.74	.71	7.68	3.00	—	—	—	11.00	10.00	—	—	59.22	40.78
17	3.37	2.29	1.03	7.35	3.00	—	—	—	11.10	10.00	—	—	65.67	34.33
.31	2.13	2.68	1.70	6.82	5.00	—	—	—	11.97	14.00	—	—	44.62	55.38

Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.
Swift's Lowell Fertilizer Co., Boston, Mass.				
Tankage	Marstons Mills	$31.90	1141	7.65
Whitman & Pratt Rendering Co., Lowell, Mass.				
Fine Ground Tankage	N. Chelmsford	29.96	952	5.14
J. M. Woodard, Greenfield, Mass.				
Unground Tankage	Conway	27.99	963	10.41
Worcester Rendering Co., Auburn, Mass.				
Ground Tankage	Worcester	36.29	793	8.54
DRY GROUND FISH				
American Agricultural Chemical Co., Boston, Mass.				
Dry Ground Fish	Bradstreet	44.43	77	10.39
Berkshire Fertilizer Co., Bridgeport, Ct.				
Berkshire Dry Ground Fish	N. Hadley	41.63	120	8.76
" " " "	N. Hadley		144	
" " " "	N. Hadley		153	
" " " "	N. Hadley		1035	
" " " "	Whately		1076	
Bowker Fertilizer Co., Boston, Mass.				
Dry Ground Fish	Hockanum	39.30	405	10.43
" " "	Northampton		452	
E. D. Chittenden Co., Bridgeport, Ct.				
Chittenden's Dry Ground Fish	Sunderland	36.99	385	6.63
National Fertilizer Co., Boston, Mass.				
Chittenden's Dry Ground Fish	Sunderland	41.23	38	10.41
" " " "	Sunderland		171	
" " " "	N. Hadley		306	
" " " "	N. Hadley		335	
" " " "	E. Whately		1090	
Chittenden's Dry Ground Fish	Sunderland	41.40	164	11.57
Olds & Whipple, Hartford, Ct.				
O. & W. Dry Ground Fish	N. Hadley	40.55	112	13.55
" " " "	N. Hadley		337	
" " " "	Sunderland		417	
Robinson Glue Co., Gloucester, Mass.				
Dried Fish Scrap	Worcester	49.56	808	7.74
Rogers Mfg. Co., Rockfall, Ct.				
Ground Fish	Deerfield	41.50	63	11.54
Sanderson Fertilizer & Chemical Co., New Haven, Ct.				
Sanderson's Fine Ground Fish	Sunderland	39.79	13	12.43
" " " "	Sunderland		57	
" " " "	Bradstreet		84	
" " " "	Sunderland		387	
" " " "	E. Whately		582	
" " " "	Feeding Hills		893	
Wilcox Fertilizer Co., Mystic, Ct.				
Wilcox Dry Ground Fish Guano	Amherst	44.10	20	8.05
" " " " "	New Bedford		213	
" " " " "	Dighton		243	
" " " " "	N. Hadley		305	
Wilcox Dry Ground Acidulated Fish	Fall River	40.81	271	16.24

Tankage and Dry Ground Fish.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Total. Found.	Total. Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Fine Bone.	Coarse Bone.
—	3.72	1.78	1.25	6.75	5.00	—	—	—	12.28	14.00	—	—	46.11	53.89
.44	.91	2.35	1.77	5.47	4.93	—	—	—	17.48	13.74	—	—	21.30	78.70
.54	.86	2.16	1.21	4.77	4.50	—	—	—	18.83	18.00	—	—	8.25	91.75
.27	4.95	1.68	1.09	7.99	7.00	—	—	—	12.00	12.00	—	—	51.73	48.27
.47	.66	4.98	2.87	8.98	8.23	—	5.10	2.10	7.20	7.00	5.10	—	—	—
.32	.67	3.85	2.11	6.95	6.59	—	10.34	6.96	17.30	15.00	10.34	—	—	—
.40	.46	4.90	2.41	8.17	8.23	—	4.26	1.10	5.36	6.00	4.26	—	—	—
—	.76	5.24	1.46	7.46	8.23	.93	2.59	3.14	6.66	6.00	3.52	—	—	—
.74	.57	4.34	2.52	8.17	8.23	—	5.52	2.14	7.66	6.00	5.52	—	—	—
—	1.20	4.72	2.35	8.27	8.23	1.48	3.26	2.68	7.42	6.00	4.74	—	—	—
.63	.87	3.64	2.85	7.99	7.40	—	6.21	1.04	7.25	6.00	6.21	4.50	—	—
.35	.50	6.11	2.19	9.15	7.77	—	9.46	4.32	13.78	12.88	9.46	9.92	—	—
1.10	1.36	3.35	2.48	8.29	7.81	—	5.75	1.04	6.79	5.00	5.75	4.00	—	—
.58	.74	4.25	2.30	7.87	8.20	—	5.76	1.38	7.14	6.00	5.76	—	—	—
.41	.44	4.52	3.61	8.98	8.50	—	5.08	1.32	6.40	6.00	5.08	4.00	—	—
.92	1.31	3.78	2.18	8.19	7.81	—	5.36	1.20	6.56	5.00	5.36	4.00	—	—

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Total. Found.	Total. Guaranteed.
SULFATE OF AMMONIA.							
American Agricultural Chemical Co., Boston, Mass.							
Sulfate of Ammonia	Boston	$74.32	360	1.07	22.52	22.52	19.75
" " "	Amherst		441				
Nitrate Agencies Co., New York City.							
Sulfate of Ammonia	Framingham	72.53	662	.61	21.98	21.98	20.56
Swift's Lowell Fertilizer Co., Boston, Mass.							
Sulfate of Ammonia	S. Amherst	73.99	440	1.74	22.42	22.42	20.00
NITRATE OF SODA.							
American Agricultural Chemical Co., Boston, Mass.							
Nitrate of Soda	Amherst		42				
" " "	Hadley		206				
" " "	Sunderland	52.67	332	1.25	15.96	15.96	15.00
" " "	Amherst		443				
Armour Fertilizer Works, Baltimore, Md.							
Nitrate of Soda	Amherst	51.68	1072	2.13	15.66	15.66	14.81
Bowker Fertilizer Co., Boston, Mass.							
Nitrate of Soda	Williamsburg	49.70	2	.75	15.06	15.06	15.00
Nitrate of Soda	Dighton		274				
" " "	Hockanum		413				
" " "	Taunton		462				
" " "	Concord	52.27	485	1.45	15.84	15.84	15.00
" " "	Northampton		518				
" " "	Bridgewater		562				
" " "	Monson		779				
Coe-Mortimer Co., New York City.							
Nitrate of Soda	Hatfield		239				
" " "	Whately	51.35	595	1.25	15.56	15.56	15.00
" " "	W. Springfield		753				
Nitrate of Soda	Amherst	48.68	1126	2.13	14.75	14.75	15.00
Lister's Agricultural Chem. Works, Newark, N. J.							
Nitrate of Soda	Hockanum	51.28	406	1.85	15.54	15.54	15.00
Nitrate Agencies Company, New York City.							
Nitrate of Soda	Fall River		303				
" " "	Seekonk		304				
" " "	Titicut	49.57	373	1.66	15.02	15.02	15.00
" " "	Concord		480				
Olds & Whipple, Hartford, Ct.							
Nitrate of Soda	Hadley	51.74	604	1.65	15.68	15.68	15.00
Sanderson Fertilizer & Chem. Co., New Haven, Ct.							
Nitrate of Soda	Bradstreet		74				
" " "	Dighton	51.61	267	2.18	15.64	15.64	15.00
" " "	Whately		596				
" " "	Gt. Barringt'n		1032				
Swift's Lowell Fertilizer Co., Boston, Mass.							
Nitrate of Soda	N. Hadley		169				
" " "	N. Hadley		301				
" " "	Somerset	51.48	315	1.19	15.60	15.60	15.00
" " "	S. Amherst		439				
" " "	Springfield		710				

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs.: As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Total: Found.	Total: Guaranteed.
NITRATE OF SODA. (Concluded).										
Wilcox Fertilizer Co., Mystic, Ct.										
Nitrate of Soda	Dighton	$51.15	281	1.58	15.50	—	—	—	15.50	15.00
" " "	New Bedford		210							
DRIED BLOOD.										
Amer. Agric. Chem. Co., Boston, Mass.										
High Grade Dried Blood	Boston	44.68	*363	12.10	1.17	2.94	3.19	2.04	9.34	9.87
" " " "	Worcester		831							
Bowker Fertilizer Company, Boston, Mass.										
High Grade Dried Blood	Northampton	47.44	*517	12.49	.17	.40	5.82	4.14	10.53	9.87
Nitrate Agencies Co., New York City.										
Ground Blood	Titicut	43.64	*379	11.41	.47	.87	4.89	3.60	9.83	9.87
Swift's Lowell Fert. Co., Boston, Mass.										
Dried Blood	S. Amherst	47.56	*438	13.08	.45	3.20	4.59	1.86	10.10	9.84
" "	Springfield		715							
CASTOR POMACE.										
Olds & Whipple, Hartford, Ct.										
Castor Pomace	Hatfield	20.24	1092	9.29	—	.52	2.03	2.51	5.06	5.00
COTTONSEED MEAL.										
American Cotton Oil Co., New York City.										
Cottonseed Meal	Southwick	26.60	*107	6.91	—	—	3.58	3.07	6.65	6.50
Buckeye Cotton Oil Co., Cincinnati, Ohio.										
Prime Cottonseed Meal	Concord	25.40	670	7.36	—	—	—	—	6.35	6.25
S. P. Davis, Little Rock, Ark.										
"Good Luck" Cottonseed Meal	Feeding Hills	24.96	892	9.32	—	—	—	—	6.24	6.50
Humphreys Godwin Co., Memphis, Tenn.										
Dixie Brand Cottonseed Meal	Deerfield	26.60	62	7.68	—	—	—	—	6.65	6.18
Dixie Brand Cottonseed Meal	Sunderland	25.28	66	8.55	—	—	—	—	6.32	6.50
Dixie Brand Cottonseed Meal (dark col.)	Sunderland	24.56	72	6.52	—	—	—	—	6.14	6.50
Dixie Brand Cottonseed Meal	Bradstreet	26.44	80	7.42	—	—	—	—	6.61	6.18
Dixie Brand Cottonseed Meal	Amherst	26.08	89	9.69	—	—	3.59	2.93	6.52	6.50
Dixie Brand Cottonseed Meal	Amherst	26.72	90	7.38	—	—	3.99	2.69	6.68	—
Dixie Brand Cottonseed Meal	Amherst	24.92	93	8.60	—	—	—	—	6.23	6.56
Dixie Brand Cottonseed Meal	Sunderland	27.96	94	7.54	—	—	4.29	2.70	6.99	6.50
Dixie Brand Cottonseed Meal	Hatfield	27.08	96	6.81	—	—	3.65	3.12	6.77	6.50
Dixie Brand Cottonseed Meal	Amherst	27.20	97	8.05	—	—	3.74	3.06	6.80	6.56
Dixie Brand Cottonseed Meal	Sunderland	26.00	98	8.92	—	—	3.60	2.90	6.50	6.18
Dixie Brand Cottonseed Meal	N. Hadley	26.24	99	8.42	—	—	3.73	2.83	6.56	6.50
Dixie Brand Cottonseed Meal	N. Hadley	25.32	100	9.14	—	—	3.34	2.99	6.33	6.56
Dixie Brand Cottonseed Meal	Sunderland	26.04	101	8.22	—	—	3.58	2.93	6.51	6.50
Dixie Brand Cottonseed Meal	Amherst	25.48	102	7.91	—	—	3.32	3.05	6.37	6.56
Dixie Brand Cottonseed Meal	Hatfield	27.68	221	8.13	—	—	—	—	6.92	7.00
Dixie Brand Cottonseed Meal	Hadley	26.32	431	10.33	—	—	—	—	6.58	6.18
Dixie Brand Cottonseed Meal	Amherst	23.72	433	9.07	—	—	—	—	5.93	6.50
Dixie Brand Cottonseed Meal	Sunderland	24.12	434	7.80	—	—	—	—	6.03	6.50
Dixie Brand Cottonseed Meal	E. Whately	25.76	584	8.20	—	—	—	—	6.44	6.50
Dixie Brand Cottonseed Meal	S. Deerfield	25.96	585	8.49	—	—	—	—	6.49	6.18
Dixie Brand Cottonseed Meal	Plainville	26.80	586	8.72	—	—	—	—	6.70	6.18
Dixie Brand Cottonseed Meal	N. Hadley	24.92	636	8.81	—	—	—	—	6.23	6.50
Dixie Brand Cottonseed Meal	Framingham	26.20	658	10.75	—	—	—	—	6.55	6.18

*No. 363-831 Phosphoric Acid 5.97%.
" 517 " " 1.86%.
" 379 " " .66%.
" 438-715 " " 5.20%.
" 107 Potassium oxide 1.90%, Phosphoric acid 2.65%.

NOTE—Castor pomace contains on the average 2.12 percent of phosphoric acid and 1.20 percent potash.

NOTE—Cottonseed meal contains on the average 2 to 3 percent of phosphoric acid and from 1.50 to 2.50 percent of potash of which about 1.28 percent is water soluble.

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Total. Found.	Total. Guaranteed.
COTTONSEED MEAL. (Concluded).										
ımphreys Godwin Co., Memphis, Tenn.										
Dixie Brand Cottonseed Meal . . .	Framingham . .	$25.32	659	10.02	—	—	—	—	6.33	6.18
Dixie Brand Cottonseed Meal . . .	Northampton .	25.76	738	8.29	—	—	—	—	6.44	6.56
Dixie Brand Cottonseed Meal . . .	N. Hadley . .	23.60	751	9.40	—	—	—	—	5.90	6.18
Dixie Brand Cottonseed Meal . . .	E. Hadley . .	26.48	909	10.13	—	—	—	—	6.62	6.18
Dixie Brand Cottonseed Meal . . .	N. Hadley . .	25.56	1034	7.96	—	—	—	—	6.39	6.56
Dixie Brand Cottonseed Meal . . .	Southwick . .	24.96	1113	9.60	—	—	—	—	6.24	6.18
'. C. Northern, Little Rock, Ark.										
Bee Brand Cottonseed Meal . . .	Sunderland . .	25.60	1085	8.91	—	—	—	—	6.40	6.50
lds & Whipple, Hartford, Ct.										
Cow Brand Cottonseed Meal . . .	Hatfield . . .	27.76	172	10.30	—	—	—	—	6.94	6.50
Dirigo Brand Cottonseed Meal . . .	N. Hadley . .	27.44	129	7.20	—	—	—	—	6.86	6.56
Cottonseed Meal	E. Whately . .	22.72	587	7.96	—	—	—	—	5.68	6.50
Dirigo Brand Cottonseed Meal . . .	Hatfield . . .	24.60	187	8.69	—	—	—	—	6.15	6.18
Dirigo Brand Cottonseed Meal . . .	Hatfield . . .	24.84	217	8.74	—	—	—	—	6.21	6.58
'. Newton Smith, Baltimore, Md.										
Dirigo Brand Cottonseed Meal . . .	Westfield . . .	25.76	891	9.40	—	—	—	—	6.44	6.56
. E. Soper Co., Boston, Mass.										
Pioneer Cottonseed Meal	Southwick . .	27.28	103	7.88	—	—	3.87	2.95	6.82	—
Cottonseed Meal	Southwick . .	26.04	104	6.43	—	—	3.41	3.10	6.51	6.50
Pioneer Cottonseed Meal	Southwick . .	26.68	105	6.95	—	—	3.56	3.11	6.67	—
Cottonseed Meal	Southwick . .	27.16	106	6.68	—	—	4.04	2.75	6.79	—
Pioneer Cottonseed Meal	Millis . . .	25.56	580	8.55	—	—	—	—	6.39	6.50
Pioneer Cottonseed Meal	Clinton . . .	25.24	872	8.93	—	—	—	—	6 31	6.50
Pioneer Cottonseed Meal	Southwick . .	27.68	1109	7.04	—	—	—	—	6.92	—
Pioneer Cottonseed Meal	Southwick . .	27.28	1110	7.40	—	—	—	—	6.82	—
Pioneer Cottonseed Meal	Southwick . .	27.52	1111	7.40	—	—	—	—	6.88	—
Prime Cottonseed Meal	Southwick . .	24.44	1112	7.90	—	—	—	—	6.11	—
Pioneer Cottonseed Meal	Southwick . .	27.60	1114	6.74	—	—	—	—	6.90	6.56

NOTE—Cottonseed meal contains on the average 2 to 3 percent of phosphoric acid and from 1.50 to 2.50 percent of otash of which about 1.28 percent is water soluble.

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
HIGH GRADE SULFATE OF POTASH.						
American Agricultural Chem. Co., Boston, Mass.						
H. G. Sulfate of Potash	Amherst		35			
" " " "	Bradstreet		83			
" " " "	Hadley	$ 52.63	204	.40	50.12	48.00
" " " "	Amherst		435			
Armour Fertilizer Works, Baltimore, Md.						
Sulfate of Potash	Feeding Hills	52.25	895	.44	49.76	50.00
Bowker Fertilizer Co., Boston, Mass.						
H. G. Sulfate of Potash	Williamsburg	52.04	3	1.78	49.56	48.00
H. G. Sulfate of Potash	Hatfield	48.63	213	1.72	46.36	48.00
H. G. Sulfate of Potash	Hoekanum	49.85	407	1.84	47.52	48.00
H. G. Sulfate of Potash	Hoekanum	49.93	411	2.35	47.80	48.00
H. G. Sulfate of Potash	Springfield	51.74	763	1.28	49.28	48.00
Coe-Mortimer Co., New York City.						
H. G. Sulfate of Potash	Hockanum	52.12	410	.51	49.64	48.00
" " " "	Whately		591			
H. G. Sulfate of Potash	Amherst	53.92	1128	.61	51.35	43.00
German Kali Works, Baltimore, Md.						
Sulfate of Potash	Lawrence		553			
" " "	Lynn	52.08	683	.50	49.60	48.00
" " "	Man'f't's Sample		1097			
Lister's Agric. Chem. Works, Newark, N. J.						
Sulfate of Potash	Hoekanum	49.94	403	.60	47.56	48.00
Nitrate Agencies Co., New York City.						
Sulfate of Potash	Titicut		376			
" " "	Sunderland	52.08	383	.33	49.60	48.00
" " "	Framingham		665			
Sanderson Fert. & Chem. Co., New Haven, Ct.						
H. G. Sulfate of Potash	Bradstreet	50.74	87	.39	48.32	48.00
" " " "	Southwick		394			
Swift's Lowell Fertilizer Co., Boston, Mass.						
H. G. Sulfate of Potash	S. Amherst		432			
" " " "	Concord	52.00	673	.79	49.52	48.00
" " " "	Springfield		702			
Whitman & Pratt Rend. Co., Lowell, Mass.						
Sulfate of Potash	N. Chelmsford	50.69	950	.73	48.28	48.00
Wilcox Fertilizer Co., Mystic, Ct.						
H. G. Sulfate of Potash	New Bedford	53.17	191	1.46	50.64	48.69
SULFATE OF POTASH-MAGNESIA.						
American Agricultural Chem. Co., Boston, Mass.						
Double Manure Salt	Sunderland		25			
" " "	N. Hadley		320			
" " "	N. Hadley	28.18	339	3.64	26.84	26.00
" " "	Northampton		514			
" " "	Worcester		822			

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
SULFATE OF POTASH-MAGNESIA. (Concluded)						
Mapes' For. & Peruvian Guano Co., N. Y. City.						
Double Manure Salt	Conway	$27.30	965*	1.16	26.00	25.96
Olds & Whipple, Hartford, Ct.						
Sulfate of Potash-Magnesia	Hatfield	28.85	1093	2.14	27.48	26.00
MURIATE OF POTASH.						
American Agricultural Chem. Co., Boston, Mass.						
Muriate of Potash	Bradstreet	43.83	5	.98	51.56	50.54
Muriate of Potash " " " " " " " " "	Bradstreet Bradstreet Sunderland Amherst	43.96	82 194 334 442	.49	51.72	49.00
Bowker Fertilizer Co., Boston, Mass.						
Muriate of Potash " " " " " " " " "	Dighton Taunton Northampton Springfield	43.11	256 467 513 764	1.53	50.72	49.00
Coe-Mortimer Co., New York City.						
Muriate of Potash	W. Springfield	44.95	756	.52	52.38	49.00
Muriate of Potash	Amherst	44.06	1121	.67	51.84	50.00
German Kali Works, Baltimore, Md.						
Muriate of Potash " " "	Lawrence Man. Sample	43.45	561 1098	1.05	51.12	48.00
Nitrate Agencies Co., New York City.						
Muriate of Potash " " " " " " " " " " " "	Fall River Titicut Sunderland Concord Palmer	42.50	313 377 380 483 772	.98	50.00	50.00
Sanderson Fertilizer & Chem. Co., New Haven, Ct.						
Muriate of Potash	Sunderland	42.40	132	.53	49.88	49.00
Swift's Lowell Fertilizer Co., Boston, Mass.						
Muriate of Potash " " " " " " " " "	N. Hadley Concord Springfield Ayer	44.00	143 671 703 1000	.43	51.76	50.00
Whitman & Pratt Rendering Co., Lowell, Mass.						
Muriate of Potash	N. Chelmsford	42.19	957	.17	49.64	50.00
Wilcox Fertilizer Co., Mystic, Ct.						
Muriate of Potash	New Bedford	44.68	215	.52	52.56	50.56
KAINIT.						
American Agricultural Chem. Co., Boston, Mass.						
Genuine German Kainit	Boston	14.28	370	1.49	13.60	12.00
Bowker Fertilizer Co., Boston, Mass.						
Genuine German Kainit	Dighton	13.61	283	1.44	12.96	12.00
German Kali Works, Baltimore, Md.						
Kainit	Man'f't'r's sample	13.36	1099	.65	12.72	12.00

*Magnesium oxide, 8.98%, insoluble matter 21.60%.

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.
DISSOLVED BONE BLACK.											
American Agricultural Chem. Co., Boston, Mass.											
Dissolved Bone Black	Boston	$12.54	362	13.30	11.07	3.09	.28	14.44	16.00	14.16	15.00
ACID PHOSPHATE.											
American Agricultural Chem. Co., Boston, Mass.											
Plain Superphosphate	Fall River	12.86	275	9.62	10.98	3.46	.52	14.96	15.00	14.44	14.00
" "	Amherst		444								
" "	Milford		727								
Bowker Fertilizer Co., Boston, Mass.											
Acid Phosphate	Hockanum	12.90	404	10.43	10.18	3.90	1.56	15.64	15.00	14.08	14.00
" "	Hockanum		409								
" "	Northampton		449								
Coe-Mortimer Co., New York City.											
H. G. Soluble Phosphate	Hockanum	13.09	412	12.61	10.58	3.96	1.00	15.54	15.00	14.54	14.00
Acid Phosphate	Amherst	12.60	1130	10.17	11.84	1.97	.90	14.71	15.00	13.81	14.00
National Fertilizer Co., Boston, Mass.											
Plain Superphosphate	Sturbridge	12.56	1101	9.17	11.08	2.76	.98	14.78	13.00	13.84	12.00
Acid Phosphate	Bradstreet	16.89	6	8.95	13.90	3.08	.48	17.46	—	16.98	—
Nitrate Agencies Co., New York City.											
H. G. Acid Phosphate	Fall River	13.68	324	3.62	9.93	5.45	.94	16.32	15.00	15.38	14.00
" " "	Titicut		375								
" " "	Concord		484								
" " "	Framingham		664								
" " "	Southwick		943								
" " "	Framingham		958								
Olds & Whipple, Hartford, Ct.											
Acid Phosphate	Hadley	14.25	203	13.09	13.43	2.57	.26	16.26	—	16.00	16.00
Sanderson Fertilizer & Chem. Co., New Haven, Ct.											
Plain Superphosphate	Southwick	14.10	936	14.06	11.83	3.67	1.28	16.78	—	15.50	14.00
" "	Gt. Barrington		1027								
Swift's Lowell Fertilizer Co., Boston, Mass.											
Acid Phosphate	S. Amherst	11.30	437	7.81	9.10	3.30	1.18	13.58	14.00	12.40	12.00
" "	Springfield		704								
Whitman & Pratt Rendering Co., Lowell, Mass.											
Acid Phosphate	N. Chelmsford	14.80	951	12.71	13.58	3.20	.06	16.84	12.00	16.78	—
Wilcox Fertilizer Co., Mystic, Ct.											
Acid Phosphate	New Bedford	14.61	197	12.54	13.73	2.77	.08	16.58	16.00	16.50	15.50

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.
BASIC SLAG PHOSPHATE.											
American Agricultural Chemical Co., Boston, Mass.											
Thomas Phosphate Powder	Leominster	$13.81	792	.08	—	16.11	2.31	18.42	17.00	16.11	14.00
Thomas Basic Slag Phosphate	Medway	12.35	1136	.24	—	13.77	3.32	17.09	17.00	13.77	14.00
Bowker Fertilizer Co., Boston, Mass.											
Basic Slag	Williamsburg	8.79	1	.42	—	6.31	9.35	15.66	16.00	6.31	14.00
Thomas Phosphate Powder	Northampton	10.00	222	.39	—	8.67	7.64	16.31	16.00	8.67	14.00
Basic Slag Phosphate	Boston	12.59	1116	.24	—	14.20	3.08	17.28	16.00	14.20	14.00
Coe-Mortimer Co., New York City.											
Basic Slag	N. Amherst	13.60	130	.07	—	15.66	2.68	18.34	17.00	15.66	15.00
" "	Concord		482								
" "	S. Amherst		590								
" "	Billerica		610								
" "	W. Springfield		754								
Basic Slag Phosphate	Amherst	14.11	1131	.07	—	15.37	4.53	19.90	17.00	15.37	15.00
Slag Meal	Greenfield	13.49	1137	.40	—	15.44	2.85	18.29	17.00	15.44	15.00
Basic Slag Phosphate	W. Springfield	13.29	1139	.69	—	15.82	1.58	17.40	17.00	15.82	15.00
J. P. Hawes, Boston, Mass.											
Basic Slag	Concord	13.45	675	.05	—	15.46	2.70	18.16	17.97	15.46	15.16
Nitrate Agencies Co., New York City.											
Basic Slag	Titicut	12.82	465	.21	—	14.75	2.55	17.30	17.00	14.75	14.50
" "	Framingham		668								
" "	Fitchburg		790								
Ross Brothers Co., Worcester, Mass.											
Basic Slag	Ayer	10.68	734	.26	—	12.56	1.58	14.14	18.00	12.56	13.00
Sanderson Fertilizer & Chem. Co., New Haven, Ct.											
Thomas Phosphate Powder	Sunderland	13.07	156	.24	—	14.69	3.30	17.99	16.00	14.69	—
Wilcox Fertilizer Co., Mystic, Ct.											
Basic Slag	New Bedford	13.69	198	.22	—	16.14	1.95	18.09	—	16.14	14.00

Name of Manufacturer and Brand.	Where Sampled.	Chemical Analysis of Lime Products.						
		Moisture.	Calcium Oxide (CaO). Found.	Calcium Oxide (CaO). Guaranteed.	Magnesium Oxide (MgO). Found.	Magnesium Oxide (MgO). Guaranteed.	Carbonic Acid (CO_2).	Insoluble Matter.
GYPSUM (SULFATE OF LIME OR PLASTER).								
American Agri. Chem. Co., Boston, Mass.								
Fine Ground Nova Scotia Plaster " " " " "	Amherst Fall River	2.40	39.45	—	.98	—	2.13	.71
Bowker Fertilizer Co., Boston, Mass.								
Plaster	Amherst	5.00	39.16	—	—	—	—	.85
Cement & Plaster Co., Fayetteville, N. Y.								
Pure Gypsum	Worcester	12.30	28.70	—	5.85	—	9.71	6.95
Red Beach Plaster Co., Red Beach, Me.								
Pure Ground Nova Scotia Land Plaster	Fitchburg	6.33	33.47	—	—	—	—	—
Swift's Lowell Fert. Co., Boston, Mass.								
Nova Scotia Land Plaster " " " "	Taunton Concord	3.26	40.16	—	1.32	—	1.73	1.07
AGRICULTURAL LIME.								
Buffalo Fert. Co., Buffalo, N. Y.								
Buffalo Brand Agricultural Lime	Beverly	5.05	49.51	50.00	.83	—	33.77	.54
Buffalo Brand Agricultural Lime	Beverly	4.85	49.03	50.00	.58	—	34.28	.51
Cheshire Lime Mfg. Co., Cheshire, Mass.								
Cheshire Agricultural Lime	Manf. Sample	.22	59.64	65.–75.	2.64	.6–2.05	28.87	1.43
Farnam Cheshire Lime Co., Farnams, Mass.								
Farnam Cheshire Agricultural Lime " " " " " " " "	Seekonk W.Springfield Pittsfield	none	62.12	60.–75.	1.00	0–1.50	30.38	1.38
Farnam Cheshire Agricultural Lime	W. Springfield	none	60.46	60.–75.	.62	0–1.50	22.43	1.18
Farnam Cheshire Agricultural Lime	Farnams	none	67.04	60.–75.	1.04	0–1.50	24.55	—
Hoosac Val. Lime & Mar. Co., Adams, Mass.								
Adams Agricultural Lime	Conway	5.05	60.93	52.6–72.64	.67	.44–1.14	14.95	1.96
New England Lime Co., Danbury, Conn.								
Adams Agricultural Lime	Man'f. Sample	.17	63.25	50.–75.	1.54	0–4.	12.24	4.14
Adams Fresh Burned Granulated Lime	Man'f. Sample	—	95.54	80.–100.	.69	0–4.	.92	1.08
Connecticut Agricultural Lime	Man'f. Sample	.07	54.53	40.–65.	20.96	15.–45.	1.66	2.00
Olds & Whipple, Hartford, Conn.								
O & W Agricultural Lime " " " " " " " " "	N. Hadley Hatfield N. Hadley Hadley	.05	60.06	60.–75	1.59	0–1.50	23.79	.99

Laboratory Number.	Cost of 100 lbs. of Calcium and Magnesium Oxides.	Probable Composition of Lime Products as based upon foregoing analyses.							
		Free Calcium Oxide (Ca O).	Free Magnesium Oxide (Mg O).	Hydrated or Slaked Lime (Calcium Hydrate $Ca(OH)_2$).	Calcium Carbonate ($CaCO_3$).	Magnesium Carbonate ($MgCO_3$).	Guaranteed Calcium and Magnesium Carbonates, Combined.	Calcium Sulfate Gypsum ($CaSO_4$). Found.	Calcium Sulfate Gypsum ($CaSO_4$). Guaranteed.
A 1, A 11	$1.36	—	—	—	2.57	2.05	—	92.27	60.00
A 45	0.89	—	—	—	—	—	—	95.04	60.00
A 27	.63	—	—	—	7.57	12.23	4.85	59.38	94.33
A 28	1.30	—	—	—	—	—	—	93.40	80.00
A 9, A 22	1.69	—	—	—	.66	2.76	—	92.33	80.00
A 23	0.89	—	—	8.63	76.70	1.74	—	—	—
A 43	0.91	—	—	6.54	76.56	1.21	—	2.87	—
A 33	0.41	—	2.64	31.38	64.05	—	25.00	—	—
A 15, A 16, A 31	0.44	7.38	1.00	21.25	68.99	—	—	—	—
A 37	0.37	—	.62	42.02	51.14	—	50.00	—	—
A 35	.33	14.25	—	30.30	53.28	2.17	50.00	—	—
A 30	0.41	—	.67	55.37	33.96	—	28.00	—	—
A 41	—	—	—	65.79	24.02	3.22	15.00	—	—
A 40	—	88.87	.69	7.27	2.09	—	0-20.	—	—
A 42	—	—	11.27*	69.25	3.78	—	10.00	—	—
A 5, A 10, A 12, A 18	0.63	—	1.59	39.35	54.03	—	50.00	—	—

*Magnesium hydrate 13.63%.

Chemical Analysis of Lime Products.

Name of Manufacturer and Brand.	Where Sampled.	Moisture.	Calcium Oxide (CaO). Found.	Calcium Oxide (CaO). Guaranteed.	Magnesium Oxide (MgO). Found.	Magnesium Oxide (MgO). Guaranteed.	Carbonic Acid (CO_2).	Insoluble Matter.
AGRICULTURAL LIME (Concluded).								
Prentiss, Brooks & Co., Easthampton, Mass.								
Rich's Standard Lime	Easthampton	.39	64.39	62.00	2.34	2.00	10.89	—
Rockland-Rockport Lime Co., Rockland, Me.								
R-R Land Lime " " " " " "	Taunton Springfield Springfield	none	62.52	55.-65.	1.49	.5-5.	21.55	1.31
R-R Land Lime	W. Springfield	none	63.74	55.-65.	.47	.5-5.	18.97	.86
Chas. Warner Co., 161 Devonshire St., Boston								
"Limoid" " " " "	Amherst N. Hadley N. Hadley Hadley N. Hadley	none	46.14	47.5-50.	31.78	31.5-34	1.28	.87
Whitingham Lime Co., Sherman, Vt.								
Agricultural Lime	Man'f. Sample	none	79.78	70.-90.	6.32	4.-7.	3.82	3.83
MARL.								
Vermont Marl Co., Brattleboro, Vt.								
Shell-Marl Land-Lime "	Amherst N. Hadley Northampton N. Hadley Amherst S. Deerfield Hadley	3.90	46.77	49.5-54.92	.96	trace	40.06	1.88
GROUND LIMESTONE.								
F. E. Conley Stone Co., Utica, N. Y.								
Raw Ground Lime	So. Sudbury	none	52.04	51.50	1.30	2.30	40.23	—
The Edison Portland Cement Co., New Village, N. J.								
Edison Pulverized Ground Limestone	Framingham	.03	43.37	50.00	1.52	1.43	40.20	8.54
LIME ASHES.								
W. L. Mitchell, 1505 Chapel St., New Haven.								
Lime Ashes	East Brookfield	5.80	37.23	30.00	—		—	—

Laboratory Number.	Cost of 100 lbs. of Calcium and Magnesium Oxides.	Probable Composition of Lime Products as based upon foregoing analyses.							
		Free Calcium Oxide (Ca O).	Free Magnesium Oxide (Mg O).	Hydrated or Slaked Lime (Calcium Hydrate Ca (0H)2).	Calcium Carbonate ($CaC0_3$).	Magnesium Carbonate ($MgC0_3$).	Guaranteed Calcium and Magnesium Carbonates, Combined.	Calcium Sulfate Gypsum ($CaSO_4$). Found.	Guaranteed.
A 32	$0.59	—	—	71.96	17.72	5.94	24.00	—	—
A 8, A 25, A 26	0.84	—	1.49	46.37	48.95	—	30.00	—	—
A 36	0.74	—	.47	52.27	43.15	—	30.00	—	—
A 2, A 6, A 7, A 13, A 14	0.92	—	19.20*	58.82	2.91	—	5.00	—	—
A 39	—	55.51	6.32	25.64	8.69	—	2.00	—	—
A 3, A 4, A 17, A 19, A 20, A 21, A 24	0.63	—	—	—	87.03	2.01	83.31	—	—
A 33	—	—	—	—	92.87	2.72	97.80	—	—
A 34	0.48	—	—	—	86.32	3.18	93.00	—	—
A 44†	0.33	—	—	—	66.44	—	—	—	—

*Probably about 18.20% Magnesium Hydrate (Mg(OH)2).
†.39% Potassium Oxide (K2O) and Trace of Phosphoric Acid.

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MASSACHUSETTS
AGRICULTURAL EXPERIMENT
STATION

The Relation of Light TO Greenhouse Culture

By GEORGE E. STONE.

Requests for bulletins should be addressed to the
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*On leave.

THE RELATION OF LIGHT TO GREENHOUSE CULTURE.

by

GEORGE E. STONE.

The greenhouse industry at the present time is at such a high state of perfection as compared with former days that the layman would have small idea of the skill attained in growing crops under glass. The grower can now control the environment of his crops so largely as to eliminate many troubles formerly common.

There is no factor associated with the construction and management of the greenhouse which does not possess a bearing on crop production. Heat, light and moisture are especially important, and the size and direction of the house, amount of air space, system of ventilation, size, quality and angle of the glass, purlins, posts, etc. are also important, as are air and soil moisture and the physical, chemical and biological features of the soil. Although a great deal is known concerning the influence of these factors upon plant growth, there is still much to be learned. The knowledge already gained has come from the long experience of an unusually skilled class of growers. Much of it is intuitive and difficult to impart to others. In many instances no definite reason can be given for certain practices.

The evolution of the modern greenhouse from the older types has resulted in a marked change in greenhouse management, which has brought about the use of larger glass and larger houses, and a relative decrease in the size of the framework (made possible by the introduction of iron), or anything tending to produce shade. As a consequence of this improvement in greenhouse construction crops are grown better and more cheaply, for in these large, well lighted houses they are less exposed to sudden changes and are consequently less susceptible to disease.

The investigations described in this bulletin* have a bearing on greenhouse construction and management, for the problem of light is one of the most important from the physiological and pathological standpoint. While greenhouse construction has progressed along scientific lines with the help of skilled builders and intelligent growers, it has by no means reached its limit of development; and many false ideas of the relation between certain greenhouse conditions and the type of construction are still held.

These experiments have been carried on for some years, and credit should be given to Mr. Neil F. Monahan, assistant for some time in the laboratory, for many of the experiments outlined, as he supervised the work. Mr. G. H. Chapman also made a few records for us, and Mr. S. C. Brooks did some of the experiments under different conditions. Some valuable tests were also made

*These were done in part on the Adams Fund under the heading—"Relation of Meteorological Conditions to Plant Growth and Diseases."

by Mr. Alexander Montgomery, Jr., formerly of the Waban Rose Conservatories, Natick, Mass., and now of the Montgomery Co., Inc., Rose Growers, Hadley, Mass.

THE PHYSIOLOGICAL EFFECT OF LIGHT.

Practically ninety-five percent of the various substances which make up the plant are derived from the atmosphere through the chemical action of light on the green coloring matter or chlorophyll bodies, primarily located in the leaves. This process is termed carbon assimilation or photosynthesis, and consists in the taking in of carbonic acid and the exhalation of oxygen. The carbonic acid is broken down, and by combining with the water obtained from the soil, forms the resultant product, starch. The spectrum rays especially concerned in photosynthesis or carbon assimilation are the orange and red, while those more particularly affecting growth are the violet colors. Artificial light affects plants in proportion to its intensity and the nature of its rays, and since it differs from sunlight very materially, it cannot be substituted for sunlight to good advantage unless some of the more objectionable rays are screened out.

Plants make the most growth in the night or in darkness, and the least in the daytime. On the other hand, photosynthesis takes place during the daytime or under the influence of light, therefore these two important processes,—photosynthesis and growth, alternate with one another. Although light has a marked inhibitory effect on growth, it favors the development of mechanical or supportive tissue which is able to resist disease. Plants grown in darkness are devoid of chlorophyll, and are consequently whitish in color, with poorly developed leaves, elongated petioles, internodes, etc. This shows the importance of light from the physiological standpoint, and explains why the lack of it is often responsible for many greenhouse troubles. Still, it must not be overlooked that too much light will under certain conditions induce an outbreak of various troubles, so that shading the crop often becomes necessary.

There are a large number of plants,—i.e., palms and others, that do not require a great deal of light. There is reason to believe that even the light common to our latitude is above the optimum for some outdoor crops. The winter light in greenhouses is too intense for some species; but carnations, roses, lettuce, cucumbers and tomatoes invariably require more light in the winter months than they receive, consequently commercial growers should be constantly on the alert for innovations in greenhouse construction tending to give better light during this period. On the other hand, light, as well as heat, which is associated with it, is often too intense for certain greenhouse crops in summer, often developing a tendency in certain plants to run to seed. Then too, the mois-

ture conditions of the soil and air in greenhouses are affected by the sun's heat in summer, making imperative more ventilation to counteract their effect.

THE RELATION OF LIGHT TO PATHOLOGICAL CONDITIONS.

As previously stated, light exerts an inhibitory effect on growth, and develops a firm, resistant tissue. For instance, the sprouts of a potato stored in a dark cellar are long, slender and whitish, with little rigidity, and they will immediately wilt and collapse if exposed to the light and heat found in an ordinary greenhouse. Darkness or even long continued cloudy periods will produce a slender, light colored, spindling plant.

While light plays an important part in the development of normal tissue, a lack of it is responsible for many abnormal conditions, and there are a number of diseases common to plants under glass which are traceable to insufficient light. Cucumbers furnish a good illustration of the truth of this statement. In some sections it is still the custom to grow cucumbers under two layers of roof glass to keep in the heat, but in the short winter days the glass, which is usually dirty from collected dust and moisture, often shuts out such a large percentage of light that the plants wilt badly. The amount of heat saved does not compensate for the loss of light; besides, this method of construction is based on wrong scientific principles and is poor economy. Plants grown under the poor light common to November and December have leaves of poor color, slender and elongated petioles, and little mechanical or resistant tissue, and when subjected to the bright sun in the early spring every plant in the house will wilt. In houses running north and south all the plants in the east side, grown in double roofed houses, will wilt in the morning, and when the sun reaches the west side, those plants will wilt badly in the afternoon. In the night the plants recover, only to repeat the wilting the following day if conditions are favorable. Plants growing under these conditions may be said to be in a state of "partial etiolation." Besides receiving insufficient light, the plants growing in houses of this primitive construction are often subjected to higher temperatures, and this has a tendency to aggravate the trouble or produce a spindling growth. Cucumber crops grown under practically normal light and temperature conditions seldom suffer from wilting, although in any house cucumbers will wilt slightly at times.

Poor light also renders cucumber plants more susceptible to powdery mildew, and possibly to timber rot, and often causes the tender edges of the leaves to wilt, turn brown and die. The large number of leaves produced in lettuce plants prevent light from reaching the stem, and stem rot (*Sclerotinia*) or "drop"

could undoubtedly be prevented if the stems were continually exposed to sunlight. Lettuce stem rot often attacks parsley and water cress, especially when the plants grow very tall and closely together, shutting out the light. Under other conditions, however, the fungus is absent. Parsley set too deep in the soil will sometimes become affected with *Sclerotinia* rot, but when set out so that the stems are exposed to the sunlight, it is never troubled with this disease.

The leaf blights of chrysanthemum and tomato, caused by *Cylindrosporium*, are associated with insufficient light and circulation of air at the base of the stem; and lack of light is responsible for many mildews. Lilac mildew, for instance, and various mildews found on grass, the strawberry and grapevine, are more common on shaded plants, as is also damping off, whether caused by *Botrytis* or *Pythium*, although moisture, heat, etc. are also important factors in producing this trouble. The lower leaves of trellissed cucumbers and melons, which are more or less shaded, become mildewed first, but such factors as moisture and vigor of the foliage are also involved. Lack of light* and excessive soil moisture have a bearing on the burning of foliage from the use of fumigants in the greenhouse, as well as on other types of burning, —top and tipburn, for example. Insufficient light has a tendency to produce immature tissue which is susceptible to winter killing, and spraying injuries appear to have a direct relationship with light conditions. On the other hand, excess of light, combined with other factors, may bring about certain troubles, but these are rare and can usually be prevented in the greenhouse by careful handling of the crop. Sun scald, for instance, is common to the white pine, moose maple and many others when grown under poor light conditions and suddenly exposed to bright light, and some plants are so well adapted to shady locations that they cannot endure direct sunlight. Asparagus, melons, cucumbers, celery, strawberries, ginseng and other plants are less susceptible to certain diseases when grown under shelter, but this condition is brought about by the absence of dews, etc., rather than of light. Too much light affects transpiration materially, and the blossom end rot of tomatoes is more severe when the light is bright than when poor.

There are innumerable factors, whether single or in combination, that affect plants and render them more susceptible to various troubles. Plants respond in various ways to stimuli, but specific stimuli give rise to specific reactions, although many factors are often involved in producing certain results. Too much or too little soil moisture will sometimes render the plant susceptible to winter killing, or in other words, corresponding results may be produced by different causes.

*The Influence of various Light Intensities and Soil Moisture on the Growth of Cucumbers and their Susceptibility to Burning from Hydrocyanic Acid Gas.—Mass. Agr. Exp. Station Rept., 1912.

In conclusion it may be stated that lack of light induces the formation of weak tissue by restricting its development, and many plants are rendered less immune to attacks from saprophytic and parasitic fungi by exposure to improper light conditions.

THE RELATION OF LIGHT TO GREENHOUSE CONSTRUCTION AND MANAGEMENT.

The most important changes in connection with greenhouse construction have been based on an increased knowledge of methods of obtaining better light. The early houses were notable for the great amount of timber used, the very small, inferior glass, and other light obstructing features. As the greenhouse industry increased, larger glass and lighter frames were employed; and development in this line has been so marked that the light conditions in a modern house are quite unlike those common forty years ago.

One of the principal results of improving the light conditions has been to greatly hasten maturity, to say nothing of the better crops secured. Since photosynthesis or carbon assimilation is in general proportionate to light intensity, any increase in the light would enable plants to assimilate more food material and to develop more rapidly. Even with an increased amount of heat it would be impossible to mature crops in the old type of house in the same time required in the modern house, the light being insufficient during the dark months of winter to build up the plastic substances required for the growth of the crop. Some growers who own old, poorly lighted houses have attempted to substitute heat for light in forcing, but diseases of all sorts usually follow such a practice.

Cucumbers, lettuce, etc. have a relatively high light requirement, and any unfavorable change in the light intensity retards their development. For instance, a few days of cloudy weather in the winter months so lessens carbon assimilation that little growth and often considerable financial loss results.

Larger houses and larger glass have had a very important bearing not only on crop production and the better control of disease, but on the economy of construction and management. Briefly, the evolution in greenhouse construction has assured more and better light, more air space, more even moisture conditions, less susceptibility to disease, improved crops and greater economy in construction and management, since a large house can be built relatively more cheaply and managed more economically than a small one.

At the present time a good grade of double thick, second quality glass is used in greenhouse construction, but formerly much double thick, third quality was used,—an inferior glass. In the primitive sashbar houses small glass of poor quality was used, and with

the heavy, light obstructing frames very poor light was obtained. Some improvement has been made in the roof angles also, houses with larger angles giving better light; in fact, the more closely the angle of the roof coincides with the right angle to the sun's rays the more light the crop receives. Low, flat hotbeds, which are usually covered with small, dirty, inferior glass, furnish a good illustration of poor angles, the light obtained being extremely poor. The old type of house, built of sashbar glass, may still be found occasionally. The glass in these houses is of all sizes and shapes, running from 2 to 5 inches wide and 2 to 7 inches long, and is sometimes lapped more than an inch. Not infrequently 50 percent or more light is shut out. With the development of the greenhouse industry larger and better glass began to be used, until now we find 16 x 24, 20 x 30 and 24 x 24 inch glass in use. Practically all this glass is second quality, double thick, although in some parts of the country much third quality glass is used even now. The most common size is 16 x 24 inches. This is usually run lengthwise of the roof, although occasionally crosswise, i.e.,— the sashbars are placed 24 inches apart, in which case one sashbar is saved every 4 feet. In a house 30 feet wide this would be a saving of about 1484 square inches of shadow casting material for each 4 feet in length. In a house 400 feet long this saving would amount to considerable, especially when the ends and sides are constructed in the same way. Where larger glass is used, less frequent lapping effects a saving in light.

Comparatively little 24 x 24 and 20 x 30 inch glass is now used, experience not justifying its use in all cases. Mr. Richard Hittinger's* large house, 40 x 600 feet, is glazed with 20 x 30 glass, but this house is so thoroughly built and purlined that it has given less trouble from breakage than his old houses, in which 16 x 24 inch glass was used. When a large glass breaks, however, it costs more to replace it even if the original cost of the glass is the same per square inch. Our experiment house, built under our direction, is glazed with 24 x 24 inch, No. 2 double thick glass. Its severe exposure makes it unsatisfactory in some ways, and we have had considerable breakage, especially on the northwest side of the house in the direction of the prevailing winds. Such a house would be much more satisfactory in a sheltered location.

The Pierson "U-Bar" type of construction employs this kind of glass. The economical use of large glass depends on the rigidity of the frame, and this type of house is provided with a rigid iron frame and iron and wood sashbars. The amount of shadow producing material is much less than where 16 x 24 inch glass is used. However to support large glass, a house must be thoroughly constructed and well purlined to prevent breakage, as has already been stated. Many of the older houses were defective in this respect,

*Mr. Hittinger, whose range of houses is located at Belmont, Mass., is one of the largest lettuce growers of Massachusetts.

the large wooden purlins allowing sagging, besides casting much more shadow than the one-inch iron purlins so extensively used at the present day. The amount of purlin required when using larger glass is scarcely more than needed in any house, for the use of many purlins is an important factor in preventing breakage, and consequently an economy in greenhouse construction. The iron house is therefore much superior to the wooden, and the truss system of construction is excellent so far as the elimination of shadow is concerned. The greater use of iron in the simple wooden house has been a great improvement, and the tendency today is to use more and more iron. But the importance of eliminating shadow producing material, or in other ways improving the light conditions, is not in our estimation as fully comprehended as it should be by either grower or constructor. An increase in the number of purlins is far less objectionable than an increase in sash.

From various experiments with the effects of shade on carbon assimilation made in our greenhouse we have been able to realize more fully how sensitive a plant is to light and shadow. Even the slightest shadow affects the process of carbon assimilation, and this in turn affects the development of the plant. As already stated, photosynthesis is in general proportionate to light intensity, and the growth and development of the plant are directly connected with it.

INVESTIGATIONS RELATING TO LIGHT IN GREENHOUSES

Methods employed in measuring Light.

In obtaining our light records we exposed tubes of a uniform size and quality of glass filled with certain chemical solutions sensitive to light. After being exposed they gradually change color, the degree of change depending on the length of exposure as well as on the intensity of light. The solution is then titrated. The figures given in our tables therefore represent the results obtained by titration by the use of a burette graduated to 1-100th c.c., but which can be estimated at 1-200th c.c. The readings are purposely expressed in whole numbers in all cases, although in most cases they represent decimals.

In some of our experiments we made use of a clock to which was attached a device for exposing the tube at any time required. This device was elaborated by Mr. Neil Monahan and proved especially convenient for early morning exposures. (See figure.)

In certain of our experiments the observations were made to determine the difference between morning and afternoon light. It sufficed for our purpose to call morning that part of the day preceding 12 m., which is known as mean time, and not the actual meridian time; and that following 12 m., afternoon.

It should be stated, however, that this method of measuring light is not adapted to an accurate measurement of the total light intensity, since the decomposition of the solution is not proportionate from hour to hour; but as the results are relative, this method answered our purpose fairly well. According to photographic light exposure tables, the light in June is from three to

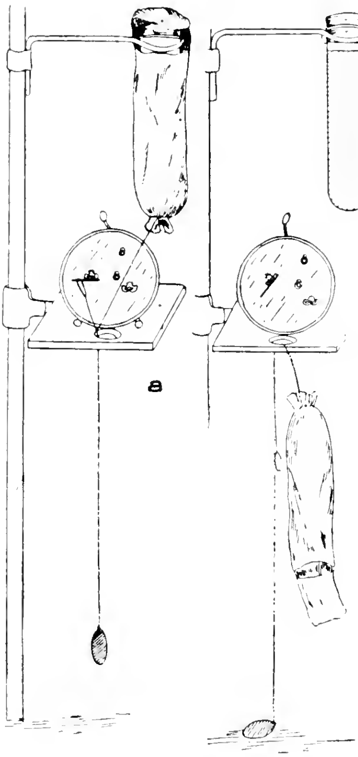

FIG. 1—SHOWING CLOCK ARRANGED FOR EXPOSING TUBES.
a. Showing clock and tube in position, covered.
b. Showing the tube exposed.
The release of the tube covering is accomplished by using the mechanism known as the alarm.

five times as bright as in December or January; besides, the days are much longer. Our records, therefore, do not give the exact light relationships existing from month to month. A variation in the decomposition of the solution would, however, tend to make the difference in our percentages greater rather than less, since the chemical solutions exposed to the stronger light would deteriorate more quickly and lose their sensitiveness sooner than the solutions which had decomposed less.

MORNING VERSUS AFTERNOON LIGHT.

A close observer will notice the effect of even small variations in the amount and intensity of light on plant development, a single cloud passing over the sun producing some effect, and a few hours of cloudiness considerable effect.

We have for many years been observing atmospheric conditions of morning and afternoon, and the difference in morning and afternoon light; and the results of observations on the growth of plants in the greenhouse have led us to believe firmly in the superiority of morning over afternoon light. In fact, one hour of morning light is in our opinion worth practically two of afternoon light in the short winter days; and while this may be somewhat of an exaggeration, there is a difference demonstrable by actual measurements. This difference may be more noticeable some months than others, but the average morning light is without doubt superior to afternoon. Certain factors other than morning light superiority may play some part in the better development of the plant in the morning, although there is no proof of this.

Mr. Alexander Montgomery, of the Waban Rose Conservatories, Natick, Mass., and a very skilled observer of plants, has for years believed in the superiority of morning over afternoon light, and many of the Waban range houses were purposely placed 14 to 22 degrees north of east instead of exactly east and west. In this position the houses are tilted toward the sun, and the plants receive the morning sun more directly, which makes it possible to syringe thoroughly without the usual risk of infection from fungi.

The writer has frequently asked experienced greenhouse managers which light they considered the better,—morning or afternoon, and he finds that few have ever given any thought to the matter. Neither do meteorologists seem to have considered the subject, and even photographers vary in their ideas as to the best time of day for their work. But for many years we have had a strong intuitive feeling that morning light is better, and therefore determined to test them out. For two years before it was possible to make an extensive study of this problem our assistant, Mr. Monahan, helped devise many types of sensitive light recorders, but all had to be discarded. By means of delicate galvanometers and self-recording instruments, however, tracings showing variations in the intensity of light were obtained, but the chemical method proved much superior, and all the records have been obtained in this way.

The records of observations found tabulated in this chapter were made during a period of one year, and while we have since made many others in connection with other lines of work, we have not thought it necessary to give them here.

In these experiments we studied the difference in morning and afternoon light in the greenhouse and out of doors from 9 a. m. to 12 m. and from 12 m. to 3 p. m.; also the differences between out of door light conditions and those in a bell-glass for the same periods of time; and again, the difference from sunrise to noon and from noon to sunset. The observations in the last two series were made for only six months.

Table I, showing difference between morning and afternoon light in the greenhouse. Exposures from 9 a. m. to 12 m., and 12 m.—3 p. m.

Month	Period of exposure.		Percentage of increased value of morning light over afternoon light
	9 a. m.—12 m.	12 m.—3 p. m.	
November	2282	1818	20.0
December	1074	0787	27.0
January	1322	1309	.9
February	2578	2396	7.0
March	2210	1867	15.0
April	2250	2033	9.6
May	3035	2622	13.0
June	3300	3023	8.3
July	3280	3174	3.2
August	3058	2845	6.0
September	3359	2928	12.0
October	2603	2287	12.0
Average	2529	2257	10.7

The experiments shown in table I, which lasted one year with practically no interruption, were made in a greenhouse 12 x 40 feet, running east and west. This was an even span house with the usual roof slope, (30°) and was about 18 years old. Eight years before these records were made it had been remodelled and glazed with new No. 2, double thick greenhouse glass, 16 x 24 inches. (See page 16). The sides had the original glass, about 12 x 22 inches. The light records were taken from 9 a. m. to 12 m. and from 12 m. to 3 p. m. at a point about 4 feet from the roof and 5 feet from the south end of the house, and in all cases showed a greater percentage of light for the morning than the afternoon; the average for the year, based on monthly averages, being 10 percent in favor of the morning light. The greatest difference is shown in November and December, where the percentage (daily average) is 20 and 27 percent respectively; while the smallest difference (only .9 percent) is shown in January. Records were also taken for a period of six months under a bell-glass, 12 x 20 inches, which extended through the roof of the greenhouse. The data are given in the following table.

Table II showing the difference between morning and afternoon light in a bell jar. Exposures from 9 a. m.—12 m. and 12 m.—3 p. m.

Month.	Period of Exposure.		Percentage of increased value of morning light over afternoon light
	9 a. m.—12 m.	12 m.—3 p. m.	
November	3262	2707	17%
December	1942	1500	22%
January	2119	2038	3.8%
February	3435	3435	0.0%
March	2970	2656	10%
April	3036	2736	9%
Average,	2794	2512	10%

These experiments were made for a special purpose, and as far as they went (six months) covered the same period as those shown in Table I. The same general difference in the morning and afternoon light conditions is seen here. The percentages are not so high as those in Table I, although the average for the six months is the same as that for one year in the preceding series. The monthly averages in all cases, however, are higher than those in Table I, a fact due in part to the concentration of the light rays in the bell-glass on the recording tube, and also to the absence of shadow. The following summary table gives the results of all the experiments, together with corresponding outdoor records.

Summary table III showing comparison of light records for corresponding periods during the day, obtained from bell jar, from greenhouse and outside of greenhouse. Records of exposure from 9 a. m.—12 m. and 12 m.—3 p. m. in all cases except in experiment field, where they were made from sunrise to noon, and from noon to sunset.

Observations made	Observation period	Exposures		Average percentage of increased value of morning over afternoon light
		Ave. Morning records	Ave. Afternoon records	
In greenhouse	12 mos.	2529	2259	10.7%
Bell-jar	6 mos.	2794	2512	10.0%
Outside of greenhouse	12 mos.	3280	2927	10 7%
Experiment field	6 mos.	5480	4889	10.7%

A comparison of the results given in the summary table shows an average difference of 10 percent. in the morning and afternoon

light when the observations were made for a period of six months or one year. This is shown in all the experiments, whether the records were taken for three hours before and following noon, or whether from sunrise to sunset. These records were all obtained the same year, the percentage of difference being based on monthly averages in all cases.

There are, of course, other methods of determining the difference between morning and afternoon light than the chemical one we used. For instance, plants free from starch might be exposed to light during corresponding periods in the forenoon and afternoon, and the amount of starch formed determined by chemical analysis; or by bleaching and treating the leaves with iodine solutions, naked eye determinations could be made as to the relative amount present. The same determinations might also be made by weighing identical parts of the leaves exposed at different periods. The crop yield in a house running north and south would afford some idea of the influence of morning and afternoon light, as would also measurements of the radii of tree stumps. All these methods have been used by us. For a few months we experimented with young cucumber plants which had been growing in the dark for 24 hours and whose leaves, therefore, were devoid of starch. One set of these plants was exposed in the morning for a certain length of time, and the other in the afternoon, and all were revolved on a clinostat, an instrument provided with a disk moving in a horizontal plane and making a revolution every twenty minutes. By this means each leaf was exposed regularly to similar light conditions. The leaves were removed and dried and chemical analyses made. Comparisons were drawn, but the results proved to be of little value from faulty chemical analyses or from other causes not determined. The amount of starch formed in leaves under different light intensities is easily determined

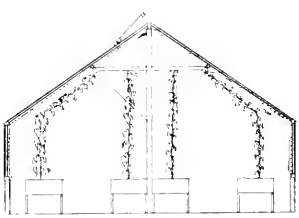

FIG. 2—Showing cross section of a typical even span, double glazed cucumber house, 20 x 106 ft., running north and south. The yield was much superior on the east than on the west side. The middle rows are so shaded in winter that they are of little value.

by the naked eye when the leaves are bleached and treated with iodine solutions, and we have made many such observations with fairly satisfactory results. The leaves containing the most starch

are the heaviest, therefore uniform blocks may be cut from each leaf and weighed on a delicate balance, and the difference in weight noted.

In many houses running north and south the crops on the east side receive the benefit of the morning light, and those on the west, the afternoon light, and from data gathered from practical growers we find a difference in yield of 15 to 30 percent. in favor of the east side plants. Even greater differences will be found by comparing the middle rows in cucumber houses with either of the outside rows, whether with an eastern or western exposure. The inside rows are often so shaded and the yield so small that it is a question whether it is worth while to grow them.

The east radii of trees growing in the open show a greater growth than the west radii. In making observations of this nature it is of course necessary to select trees not shaded by other trees or by buildings, if reliable results are to be had.

A long row of ash trees, planted in 1882 an equal distance apart on a road running north and south, was examined very carefully a few years ago, an opportunity offering when it became necessary to sacrifice every other tree. The north, east, south and west radii were carefully measured and the growth found to be 24 percent. greater on the east than the west side of the tree. This high percentage may be explained by the fact that the roots were more favorably located for growth on the east than the west side, where some had been amputated. Practically all of the substances which make up the bulk of the tree are obtained from the foliage through the process of photosynthesis, and if the light is better on the east side of the tree than on the west, carbon assimilation will be more active and more plastic substances, used in growth, will be found there.

A large number of measurements of forest trees, some of which were 200 years old, showed that the east radii were about 17 percent. larger than those on the west side. Most of the measurements were taken from stumps cut from 2 to 5 feet above the ground, and the unequal growth often formed by large roots near the surface was not present. Trees growing on the eastern slopes of mountains show an unusual development of the east radii, while those on the western slopes show the greatest growth on the west side, as might be expected. The records obtained from tree measurements undoubtedly represent quite fair averages of morning and afternoon light, as many seasons' growth is included.

We have, therefore, more than one way of determining the difference between morning and afternoon light, any one of which is capable of giving fair results.

It will be observed that the results obtained from the chemical method differ somewhat from those obtained from the measurements of trees; but in the former case the data are for only one

year, while the tree measurements represent a great many years' growth. The records obtained from the growth of plants in the greenhouse invariably run higher than those obtained by the chemical method or the tree measurements, but this is due to the fact that greenhouse crops are grown only during certain seasons, when the difference is often 30 percent. in favor of the morning light.

There are many reasons why morning light should be better than afternoon light. While we cannot here consider all the factors entering into a problem of this nature, two of special significance in inhabited regions are smoke and dust. Although the difference between morning and afternoon light may be greater in commercial centers than in the country, our measurements of trees 150 to 200 years old show that there was a difference before the advent of civilization. According to our observations, made from an elevated point, distant points are most clearly seen in the early morning. As the day advances the atmosphere becomes less clear, for fires are everywhere being made, the highways once again become busy thoroughfares and a cloud of smoke and dust is sent into the air to accumulate during the day and diminish the light intensity. The atmosphere also seems to be more free from clouds in the morning, but we have not attempted to study sunshine records in regard to this point. Observations made at high and low elevations throw some light on the effect of dust and smoke on the air, the light at high points being superior, but the difference gradually grows less during the day owing to the ascent of smoke and dust.

The foregoing observations have a practical bearing on the direction in which the greenhouse should be placed in order to obtain the best light. As already pointed out, a house running in an easterly and westerly direction should be placed toward the north to receive the superior morning light to the best advantage. A house set 20 to 25 degrees north of east would be better placed than one running directly east and west.

DIFFERENT QUALITIES AND KINDS OF GLASS.

As might be expected, the kind and quality of glass vary greatly. We made no attempt to test more than a few types,—chiefly those used in greenhouses. Some of the samples were obtained from the Boston Plate and Window Glass Company, a firm which retails large quantities of greenhouse glass.

The experiments were made out of doors, and the exposed tubes were placed in boxes 2 1-2 inches from the glass which we wished to test. The records shown in the table are averages of four different experiments in which the exposures ranged from 2 to 2 1-2 hours. In all the tests 16 x 28 inch glass was used. No. 1 was double French, first quality; No. 2, double French, second quality, and No. 3 American, third quality. The fluted glass was

1-8 inch thick, with rather fine flutings and a general appearance of opaque glass. The No. 2 French, double thick, is used extensively in greenhouse construction in the east, and the No. 3 American in other sections of the country. The fluted glass is not used for greenhouses, although it is valuable for dispersing light.

The difference in the quality of the glass tested was sufficient to enable one, with no previous knowledge of how they were placed, to pick out each sample at a distance of six rods. The results of the tests given in the table show that the differences in the quality or light transmitting properties of the glass are marked. The No. 2 gave 17 per cent. less light than No. 1, and No. 3, 32 per cent. less than No. 1, while the fluted glass was practically as good as No. 3, although from its opaque appearance it could hardly be thought to compare with any of the others. The relatively high records given by this glass are explained by the fact that the flutings act as lenses, and it is evident that the rays of light in our experiments were concentrated upon the recording tubes, which were only about 2 1-2 inches from the glass, and the readings obtained from this glass are probably somewhat misleading.

The cost of the different qualities of glass at the time of purchase was as follows: No. 1, 42c; No. 2, 39c; No. 3, 33c; the fluted, 20c per light. Considering the results obtained from the different types of glass, No. 2 would seem a wiser purchase than No. 3. Large dealers say that they sell nine boxes of French glass to one of American in the east for greenhouse use. According to this schedule of prices, those who purchase No. 2 glass pay six cents more or 15 per cent. more than those who buy No. 3, but receive 18 per cent. more light. We believe that it would pay to use No. 1 quality in some special cases.

Since most plants receive far below the optimum light in the winter months in our latitude, the choice of glass should have careful consideration. In the spring and summer this is less important, and in many cases it is even of advantage to shade the plants at this time. However, the amount of light is not dependent wholly on the quality of glass, as the size of the house and methods of construction are important features, and will be discussed elsewhere.

Table IV showing results obtained from different kinds and qualities of glass.

	Readings.	Percentage of decreased light value.
1st quality glass,	188	100
2d quality glass,	155	82
3rd quality glass,	126	67
Fluted glass,	125	66

COMPARISON OF NEW WITH OLD GLASS.

A few tests were made to ascertain the difference between new and old glass as regards light transmission. In one test, new No. 2 second quality greenhouse glass was compared with the same quality of glass which had been in use for some years. The exposures were of three hours duration. Below is given an average of three experiments with two different types of glass:

New second quality greenhouse glass .... [illegible]
Old second quality greenhouse glass .... [illegible]
Difference [illegible]

The old glass was taken from a house which had been used for some years, and was not especially clean, but no attempt was made to clean either sample except to remove the dust. It was found that the new glass transmitted [illegible] per cent. more light than the old.

A similar experiment was conducted in two houses of the Waban Rose Conservatories, Natick, Mass. One of the houses was new and the other was built thirty years ago. The grade of the glass in the older house was not known, but it was apparently of similar quality (probably in both houses — [illegible] double thick, second quality). The angle of the roof in each house was [illegible] and the location of the houses as regards points of the compass was the same. The results of readings are shown below:

House one year old .... [illegible]
House [illegible] years old .... [illegible]
Difference [illegible]

These are comparisons of the roof glass and represent only the difference. [illegible] per cent. is a rather insignificant percentage, considering the length of time the older glass had been used. Many factors enter into a problem of this nature, such as dust, minute scratches from particles of [illegible], films and stains from the [illegible], and there may possibly be a difference in the chemical composition of the glass itself since some of the older types are known to undergo quite marked changes in color due to age and exposure. Experiments of this nature are [illegible] of very relative value; nevertheless it is possible to learn something about the deterioration of glass from year to year. The [illegible] per cent. difference in the [illegible] year old and [illegible] year old glass [illegible] may be due to the accumulation of dust and dirt [illegible], and in all probability the deterioration [illegible] would be considerably less than [illegible] per cent. per annum — perhaps not more than [illegible] per cent.

THE EFFECTS OF DIFFERENT ANGLES OF GLASS ON THE LIGHT IN GREENHOUSES.

It is well known that light will penetrate a transparent object more easily when the object is placed at right angles to the rays of light. Although greenhouse constructors and managers realize this, for many reasons most greenhouse roofs are built at different angles regardless of the loss of light resulting from reflection. Moreover, the sun not only strikes the house at different angles during the day, but at different seasons of the year, so that there is a great deal of variation in the light reflection. But the houses with greater roof angles, in which there is less reflection, allow more light to pass through, and of course there would be a gain in light transmission by utilizing angles which would give the maximum average effect in certain seasons. For instance, a house having an angle of 60° will transmit more light than one with a 20° angle.

A few observations on the amount of light lost by reflection were made with glass placed at different angles. In two houses running east and west, with roof angles of 32° and 40° respectively, tubes were exposed from 8 a. m. to 4 p. m. with the following results:

House with roof angle of 32° gave a reading of 445.
" " " " " 40° " " " " 545.

Difference, 18%.

These observations were made February 8, when the sun was not very high. The roof with an angle of 40° was much better adapted to allow the light to pass through the glass at that time of the year than the other house. Another experiment was conducted in which glass of different quality was placed at different angles with the following results:

Table V showing the amount of light transmitted at different angles. Duration of experiment—3 hours.

Angles of Glass.	Readings.	Relative percentage value of different angles (90°—100%).
90°	325	100%
60°	310	95%
50°	273	84%
10°	230	71%

These results are an average of three experiments made in the third week of January, when the sun was not very high. In each case exposures were made from 9 a. m. to 12 m. The glass was

placed from the horizontal at angles of 10, 30, 60 and 90 degrees, the 90° glass of course being vertical. The differences shown are those between each angle, the difference in the absorption of light at 90° and at 10° being 29 percent. The glass placed at 60° was nearly as well situated for absorbing rays at this season of the year as the one at 90°, there being but 5 percent. difference between the two, and 24 percent. difference between any 60° and 10° glass.

From the results of these experiments it is quite evident that there is much loss of light from reflection, and some growers of special crops have attempted to overcome this loss by constructing roofs with greater angles.

REFLECTION OF LIGHT FROM DIFFERENT SURFACES.

As might be expected, there is considerable difference in the amount of light reflected from different surfaces. White is the principal color used on the outside and inside of greenhouses, either lead paint or whitewash being used, but most of the iron work is dark in color. Some tests were made of aluminium bronze, white and dull black paints, the colors used in our own greenhouse, to determine their value as reflectors of light. In our experiments we used both metal and boards painted with the above named substances, and in some experiments not given here we tested various other surfaces. The tests were arranged in such a way that the direct sunlight was excluded, although the recording tubes were undoubtedly affected to some extent by diffused light. This, however, was the same in each test and can therefore be eliminated in our comparative tests. The tests were made in bright sunlight out of doors. The tubes were arranged in such a way that they would receive the full benefit of the reflected rays.

The results of these experiments follow.

Table VI showing the amount of light reflected from different surfaces. Average of three experiments.

Reflecting surfaces.	Reading	Aluminium bronze—100%.
Aluminium bronze, . . .	377	100%
White paint, ...	330	88%
Dull black paint, ...	209	82%

It will be observed from the table—an average of three experiments with metal backgrounds—that the aluminium bronze reflected the largest percentage of light, followed by white paint and by dull black paint. The white paint reflected 12 percent. less

than the aluminium bronze, and the dull black, 6 percent. less than the white paint. The recording apparatus receiving the reflection of the dull black showed that 18 percent. less light was reflected than the aluminium bronze.

Table VII showing the Amount of Light Lost from Reflection from Sky, Etc. Average of three Experiments. Exposures, three to six hours duration.

	Readings.	Sky—100%.
Exposed to sky	233	100%
Not exposed to sky	164	71%

In another single experiment in which boards were painted with aluminium bronze, white and black paints, similar results were obtained, although there was a difference in the percentage of light reflected from various surfaces. Assuming that the light from aluminium bronze was equal to 100 percent., the white board gave 80 percent. and the black, only 58 percent.

From these tests it is evident that there is quite a difference in the various reflecting surfaces, and that something might be gained by using substances reflecting the most light. In our experiment house the iron posts and purlins are painted white, and the steam pipes black. The cement walls, which are about 2 1-2 feet high, have a coating of water paint, and the water pipes are dressed with aluminium bronze. This possesses a high reflecting surface, and might be used on exposed steam pipes, etc. to advantage.

The light reflected from the sky and from adjacent buildings is an important factor in the greenhouse light problem, and experiments were made to learn how much light was reflected through the roof glass on the north side of a greenhouse. Both exposures, which were made about 10 inches from the roof glass, were entirely protected on the south side, and received no direct sunlight. In one case the reflected light from above was shut out, and in another, not; although both exposures received reflected light from a cement walk below. An average of results obtained from three experiments is given in table VII. The experiments demonstrated a marked difference in the amount of light received at each exposure, all of which were made on bright days. A large brick building having considerable window surface was located about thirty feet from the tubes, and some light was probably reflected from this structure, although the apparatus was so placed that it did not receive any direct reflection from the building. This test showed that considerable reflected light entered the greenhouse even on the northern slope of the roof. This was true also of the

north side of the greenhouse. Some types of houses, especially those known as the two-thirds span roof, are boarded up on the north side, and the loss of light in this style house could perhaps be counteracted by using some good reflecting surface.

The reflecting properties of snow are of course generally known. Some tests made on a sunshiny day, when the ground was covered with snow, gave some rather interesting but perhaps not conclusive results. In one instance, where one tube was exposed to direct sunlight and snow reflection, and the other merely to the direct sunlight and light from the sky, we found a difference of about 17 percent. in the light intensity in favor of the first case.

LOSS OF LIGHT FROM LAPPED GLASS AND SHADOWS.

Three series of experiments were made in a three year old greenhouse to determine the loss of light from lapping glass, in which we compared the light transmitting properties of lapped glass, where the laps had become more or less opaque from an accumulation of dust, etc., with those of glass not lapped.

In these tests the light recording tubes were covered with opaque black paper, and exposed alternately with the lapped and unlapped glass. Slits of exactly the same size were made in the paper, of approximately the same width as the lap, and in this way the tubes received in each case only the light which passed through these slits. The glass was typical second quality greenhouse glass, and the lapped areas were about 3-8 of an inch. The results are shown in the following table.

Table VIII showing the loss of light from lapping glass. Average of three experiments.

	Readings	Non-lapped —100%
Amount of light through ordinary glass, ...	380	100%
Amount of light through lapped glass, ...	341	89%
Loss, 11%.		

From the results of these experiments it will be seen that there was a loss of 11 percent. of light through the lapped areas. It should be borne in mind, however, that the tests were made in a comparatively new house, where the lapping was not wide and the accumulation of dust comparatively small.

We obtained similar results in another series of three experiments, made with the same idea. The exposures were of two hours duration, and an average of the three tests gave 309 for the

clear glass and 273 for the lapped glass, or a difference of 11 percent. In the older houses, where the lapping is often wider and considerable dust has accumulated, the percentage of loss would probably be higher than in these tests.

The lapping in a house amounts to quite an area in all. In a house 30 feet wide there would be 440 inches in one section of the roof 2 feet wide, provided 24 x 24 inch glass were used, and each glass lapped 3-8 inches. In a house of this same type, 100 feet long, the lapping would amount to 7200 square inches, or 50 square feet. Lapped glass, however, is better than butted glass with the present methods of construction and material.

The loss of light from shadow casting material is quite marked, and affects to a considerable extent the photosynthetic process and the amount of carbohydrates formed in the leaves. Two experiments were made in the greenhouse to determine the loss from shadow casting material, and the table below gives the average of both. In one experiment the exposed recording apparatus received the direct light through the greenhouse roof, with no shadows, and in another the apparatus was placed in the shade of a 2 x 4 wooden beam, some 8 feet distant from it, where it was in the shade of the timber all the time.

Table IX showing amount of light lost from shadows. Average of two experiments. Duration of experiment, two hours.

	Readings.	Direct sunlight —100%
Greenhouse experiment,—no shade,	374	100%
Greenhouse experiment,—in shadow of 2 x 4 timber,	225	66%

The difference in the two readings shows a loss of 34 percent. from shadows. The loss of light caused by shadows and its effects on photosynthesis can be determined by various experiments. For instance, two pieces of cork pinned to a leaf, one on each side, cause starch to disappear from the leaf, and even the shadow cast by the cork will affect materially the starch formation of the part of the leaf where it falls. (See fig. 3). A photographic negative placed on a leaf also affects the starch formation, the leaf acting as sensitized photographic paper. Under the opaque part of the negative little starch will form, but there will be more under the light part. A leaf so exposed, when bleached and treated with iodine, will bring out a reproduction of the negative in black and white, and this would be a good method to demonstrate that photosynthesis is in a general way proportionate to light intensity.

INTENSITY OF LIGHT AT DIFFERENT DISTANCES FROM THE GLASS.

For many years there have been conflicting opinions in regard to the light in greenhouses. An old idea which has been handed down from generation to generation and which has even been taught in some of our institutions is to the effect that it makes considerable difference in its growth whether a plant is near the glass or some distance from it, the light being thought to be more intense near the glass. It has been stated that even lettuce and cucumbers must be near the glass for the best growth.

Modern greenhouse construction, however, has in the main followed lines quite the reverse, the larger houses meaning a greater distance between the glass and the plants.

The author of an article in the "Gardeners' Chronicle", London, quoted in "Horticulture",* regrets the modern tendency towards large houses. He mentions the difficulty of getting plants started where they are so far removed from the glass, and also calls attention to independent circuits of air and the susceptibility of plants to attacks from green fly, mildews, etc. Mr. Alexander Montgomery, Jr., who was making light tests in his houses when this article appeared, comments on the article in "Horticulture" as follows:

"The question of large versus small houses, as it presents itself to us, is one which will have to be settled in the dear school of experience. The subject has of course two separate phases; first, the cost of construction and maintenance of large as compared with small houses, and second, the question as to which is capable of producing the higher grade of flowers. The first, we believe, is generally conceded in favor of large houses by those who have considered the matter at all. The second is evidently the point which is giving the critic in the above notes some cause for worriment.

His complaints resolve themselves into two divisions; dangerous draughts owing to extreme length and width, and lack of light on account of the distance of the plants from the glass. If a house 40 feet wide and 700 feet long may be considered large, we can say, as far as our experience goes, that the fears of our critic are not well founded in either case. In this structure the temperature and ventilation, both day and night, are under more perfect control than in any other house on the place, and we are firmly convinced that, in this respect at least, it is very much superior to the eight small houses which it would require to cover the same amount of ground.

The point in regard to light we think we have settled, for this house at any rate. Ordinarily the test for this would be by close observation of the plants at the varying distances from the glass.

*Horticulture, Vo. VIII, No. 12, March 21, 1908, p 361. See also Horticulture, Vol. V, No. 10, March 9, 1907, p. 286.

Applying this rule we must say that, so far, it would take a considerable stretch of the imagination to discover any difference in the plants which could be attributed to lack of light caused by distance from the glass. But we have also used another method. It consists briefly in the determination of the varying intensity of light by a chemical method, and we have been assured that it is extremely sensitive and absolutely accurate. Carefully applying this test we have been able to find no difference between light 5 feet from the glass and 25 feet. There may be a point at which some difference will be found, but someone will have to seek for it in a house considerably wider than 40 feet.

If the time ever comes when, in place of the whims and fancies of weak and mortal man, we have exact scientific methods for solving the complex problems of the adaptability of glass structures to plant growth, then and not until then, will the perfect greenhouse be produced."

The many tests which we have made are identical with Mr. Montgomery's, who used our apparatus. We found that there was no perceptible difference in the light intensity in different parts of greenhouses except that caused by shadows, dirty glass, etc. In some of our tests, which lasted practically a whole day, we recorded the conditions of the light at distances varying from 5 feet to as great a distance as we were able to obtain in houses 40 feet wide, with precisely the same results. Greenhouse glass has a more or less uneven surface, besides being somewhat concave, and for this reason the light waves as they pass through are more or less deflected. The maximum effect of such deflections, however, is to be seen close to the glass; and as one gets farther away from the glass a more or less uniform diffusion is secured. In fact, the farther away the plants are from the glass the better, for at a distance they obtain a more uniformly diffused light which renders them less liable to injury from concentrated rays through irregularities, glass bubbles, etc. In many instances we obtained larger readings from our tubes exposed directly under the glass than elsewhere, the irregular glass acting as a lens and concentrating the rays. Even the small shadows in a greenhouse diminish and are lost sight of at certain distances from the glass, therefore produce no visible or local effect on the plant, although the shadows cast by opaque objects do affect the light intensity as a whole. Uneven surfaces and bubbles, characteristic of greenhouse glass, must be regarded as a drawback, since an even, smooth glass will transmit light more uniformly and improve the light conditions; consequently some improvement in greenhouse lighting may be had by using better glass.

As regards draughts, etc. in the large houses, these will be found in all houses whether large or small, and it is apparent that the best system of ventilation has not been worked out as yet either

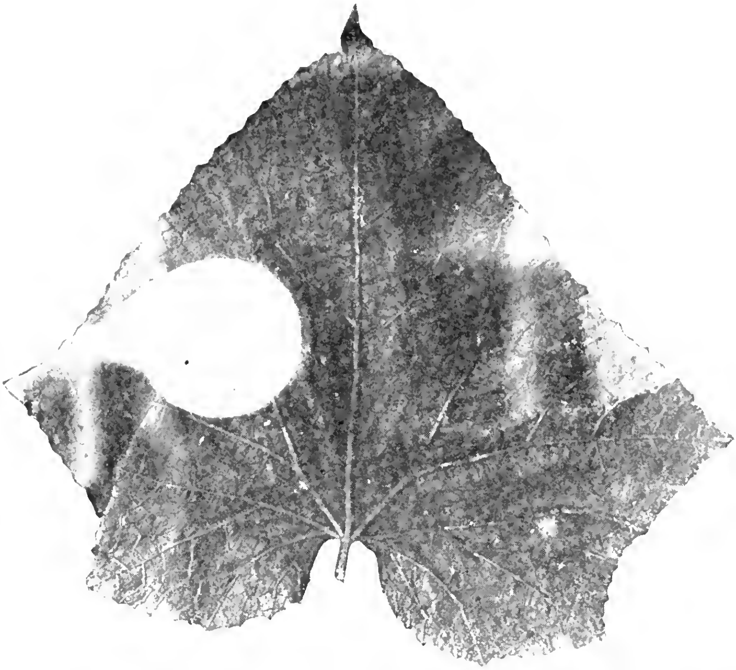

FIG. 3—Showing cucumber leaf with absence of starch formation where cork was pinned. Note also the effect of the shadow of the cork on the formation of starch.

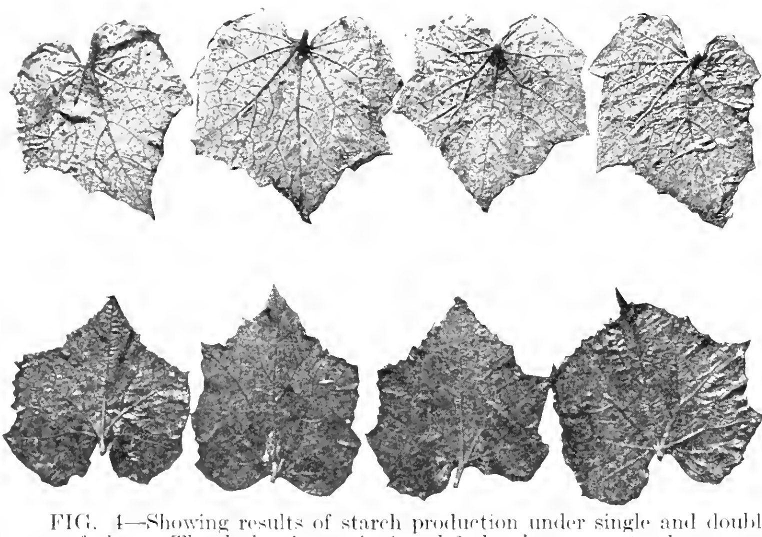

FIG. 4—Showing results of starch production under single and double panes of glass. The darker leaves in 1 and 2 showing more starch were exposed to a single clean light of glass; the lighter leaves were exposed to two unclean lights of glass.

in the greenhouse or in public buildings. Most ventilators are located at the ridge, and cold draughts often descend and check the growth of plants. Allowing the fresh air from the outside to enter around the steam pipes would seem to be theoretically correct, but we have had no experience with this method.

The management of a large house is always easier owing to the less sudden changes in temperature, moisture, etc.; and as for mildews and other troubles, they are always more common in small than large houses.

Table X showing light records taken at different distances from the glass.

No. of Experiment.		Readings.
1	Light records at 5 feet from glass	360
	" " " 20 " " "	355
2	Light records at 6 feet from glass	335
	" " " 18 " " "	334
3	Light records at 6 feet from glass	259
	" " " 18 " " "	254
4	Light records at 5 feet from roof and 10 feet from side	300
	" " " 50 " " " " " 30 " "	305
5	Light records at 5 feet from roof and 10 feet from side	260
	" " " 5 " " " " " 30 " " "	270
6	Light records at 5 feet from roof and 10 feet from side	500
	" " " 5 " " " " " 30 " " "	503

LOSS OF LIGHT FROM GLASS, ETC.

As might be expected, there is a loss of light in greenhouses from reflection and other causes. The light lost from reflection depends on the angle of the glass to the sun's rays, and as the sun's altitude varies continually during the day and year, the light intensity also varies. Moisture condensation, snow, frost, dust and the composition and quality of the glass have a great influence on the light, and light in turn affects the growth of the crop so materially as to cause many different troubles. For years we have been making numerous greenhouse tests in different parts of the state in houses of different ages and types of construction, and during this time have been studying these different conditions and their relation to disease.

In all cases the light conditions out of doors were compared with those in the greenhouse, and the loss based on the differences between the two. Some of the results follow.

Table XI showing loss of light in some typical Massachusetts greenhouses running east and west. Outside light conditions in open air equals 100%.

No.	Direction of house.	Age of house.	Percentage of light excluded.
1	east and west, 12° North.........	8 yrs.	23
2	east and west, 22° North.........	15 yrs.	22
3	east and west, 22° North.........	15 yrs.	22
4	east and west, 22° North.........	About 3 yrs.	24

All glass 16 x 24 in., but in No. 4 the glass was placed lengthwise; that is, the rafters were 24 inches apart.

The data given here were obtained from large, modern rose houses running east and west. The tests were all made in the winter, in bright sunshine, when snow was on the ground, and are averages of two experiments, running from 8 a. m. to 4 p. m. in one case, and from 1.30 to 4 p. m. in another. The readings were in all cases taken 5 feet from the roof glass, a favorable location for obtaining average results. The houses ranged from 20 to 40 feet wide, and 300 to 700 feet long, and some were built of wood, others of iron. All had about the same roof angle. No. 4, an iron house, had iron rafters 4 inches wide. None of the houses was over 15 years old, and all were in excellent condition in every respect. Houses Nos. 1 and 4 were newer than Nos. 2 and 3, but the heavy iron rafters in No. 4 cast a greater shadow. Very little difference was shown in the percentage of light lost in these houses, where the period of exposure occupied nearly the whole day. Other records taken at shorter intervals during the forenoon, as well as in the afternoon, showed greater differences in the light records of the houses. In all cases No. 4, which was the newest house and had 16 x 24 glass, lengthwise, gave the best results. No. 1, which was not a very old house, gave the next best, and Nos. 2 and 3, slightly older, made of wood and glazed with older glass, did not show up so well in the morning and afternoon records for short periods. The large iron rafters in No. 4 cast heavy shadows, and this is probably one of the reasons why the light conditions in this house did not show up better. All these houses are located in the country where they were not subject to dust and smoke. The loss shown even by the older houses, namely 22 percent, is small as compared with other houses not so favorably located or so well constructed.

The following table shows tests made in houses of different ages and types of construction, running north and south. All the readings were made five feet from the glass.

Table XII showing loss of light in some typical Massachusetts greenhouses running north and south. All results are of one test made in winter. Outside light conditions in open air equal 100%.

One layer of glass except where specified.

No.	Size of glass	Percentage of light excluded	Age of house	Remarks
1	9 x 12 in	35	old	Sides double glazed
2	9 x 12 in	31	old	Sides and roof double glazed.
3	12 x 16 in	19	new	
4	16 x 24 in	28	15 yrs.	
5	Variable	36	old	Glass very dirty.
6	16 x 24 in.	30	old	Sides and roof double glazed.
7	16 x 24 in.	18	5 yrs.	Glass clean.
8	16 x 24 in.	13	1 yr.	Glass clean.

It will be noticed that several sizes of glass were used in these houses. In some cases the houses were double glazed either on the side or roof, or both; i. e., besides the glass set in the top of the sashbar there was another layer on the underside, with a space of 1 1-2 or 2 inches or more between them. These houses were all about 18 or 20 feet wide and 80 to 200 feet long except No. 4, which was 80 feet wide and about 300 feet long. No. 1 was an old house with double glazed sides and poor light. No. 2 was double glazed on both sides and roof. No. 3 was a new house with fairly clean glass, while No. 4 was a large house of unusual width and about 15 years old. No. 5 was glazed with different sized glass which was so dirty as to exclude considerable light. No. 6 was double glazed both on the sides and roof, and Nos. 7 and 8 were new, modern houses. This series of houses is by no means typical of modern greenhouses in this state except Nos. 7 and 8, since most are glazed with smaller glass than that used at the present day. Moreover, some of them were double glazed, an antiquated, unscientific and impractical type of construction found only in certain locations, and already referred to.

The tests given here had a duration of two or three hours and represent readings obtained from the glass alone; shadow casting material being practically eliminated. The results show fairly well the percentage of light excluded in this type of house, but to get reliable averages it would be necessary to run experiments all day long for a definite period, as the condensation of moisture occurring between the two layers of glass varies from day to day.

All these houses were of the same width, angle of roof, etc. except No. 4, already mentioned. Some of them were too heavily framed, but Nos. 7 and 8 were good, modern houses, kept clean, and the owner is one of the most successful cucumber growers in the state. The single and double glass houses gave the poorest results from the light standpoint, and the newer houses proved superior in this respect.

The following tests were made in some of the greenhouses located on the College grounds.

Table XIII showing records based on 4 experiments taken in some of the college greenhouses. Observations taken from 9.30—11.30 a. m. and from 1.30 — 4.00 p. m., in July and August. Outside light conditions in open air equal 100%.

House.	Direction of House.	Approximate Age.	Angle of Roof.	Percentage of light excluded.
Entomology	North and south	12 yrs.	31°	16.2
Clark Hall	East and west ..	3 yrs.	34°	18.5
French Hall, Rose house	East and west ...	3 yrs.	34°	23.9
Durfee upper house	North and south	17 yrs.	18°	28.8
Exp. Station, veg. house	North and south	12 yrs.	16°	30.6
Exp. Station, south house	East and west ...	14 yrs.	30°	32.6
Durfee lower house		17 yrs.	20°	34.0

These houses represent a variety of types of construction and were built at different periods, therefore it was to be expected that the light conditions would vary. The data given here represent an average of four tests made in the morning and afternoon, in July and August, the houses being arranged in the table according to the amount of light excluded. The sequence, however, does not follow exactly that given above, when the morning averages are compared with those of the afternoon. This difference is accounted for by slight differences in the morning and afternoon exposures and methods of construction. The ages of the houses varied, and some of them have been remodelled at different times. It will be noticed, however, that the houses showing the best light conditions are as a rule the ones most recently constructed. French and Clark Hall conservatories were both built in 1908. The latter,—a Stearns wood frame construction, is glazed throughout with 24 x 24

inch No. 2 glass, while the former, of Lord & Burnham iron construction, is glazed with 24 x 24 inch glass on the roof, and on the sides with 16 x 24; i.e., 16 inches between sash bars, hence the light conditions in one house are slightly better than those in the other.

The least loss of light is given by the entomological conservatory. This house is a Weathered construction, with curvilinear roof, and is well lighted. The glass, however, is 16 x 24 inches and of the same quality as that in the other houses. Its excellent light may be partly due to reflection from the partition wall, which we could not very well avoid. The curvilinear construction of the house, however, undoubtedly adds much to the light.

The Experiment Station vegetation house, built twelve years ago, runs north and south and has sides 7 feet or more high. The Experiment Station south house runs east and west. It is about 12 x 40 feet and is 14 or 15 years old. The Durfee lower house is nearly square, the roof slanting towards the south and also towards the east. The sides are 7 or 8 feet high, and both roof and sides are glazed with 16 x 24 inch glass. This house was remodelled about 18 years ago. The upper house is about the same age, and this and the preceding one, have low angle roofs.

In all cases our tests were made the same distance from the glass in the roof and sides, except in the north and south houses, where the readings were taken at some distance from the glass. These 2 or 3 hour tests show the effects of the age of the glass, although they are fairly typical so far as the relative light conditions are concerned, in all cases being based on the outdoor readings. In the preceding tables we have given the loss of light in greenhouses based on outdoor observations for brief periods, and in the following table they are given for more prolonged periods.

The records in the following table, which show average monthly light conditions, will convey some idea of the light in greenhouses as compared with that out of doors for a whole year. The tests lasted only three hours in the morning and three in the afternoon, or from 9 a. m.—12 m., and 12 m.—3 p. m., the location of the greenhouse preventing longer periods of exposure. The greenhouse was 12 x 40 feet, having an even span roof glazed with No. 2, 16 x 24 inch, double thick glass. The direction was east and west, or to be more accurate, about 25° north of east, and the recording tube was placed 5 feet from the glass and 5 feet from the south wall. The glass in the roof had been in use for about 8 years, and that on the sides about 10 years longer. The wood framework was not as light as it might have been, but the exposed tube was placed where it could receive direct sunlight through the roof.

Table XIV showing difference in light inside and outside of greenhouse for a period of one year. Records taken daily from 9 a. m. to 3 p. m.

Month.	Outside records.	Greenhouse records.	Percentage of increased value of outdoor light over greenhouse light.
November	5665	4100	27%
December	3277	1861	43%
January	4002	2631	34%
February	6301	4974	21%
March	5538	4077	26%
April	5683	4283	24%
May	7148	5667	21%
June	7511	6323	15%
July	7590	6454	14%
August	7647	5903	22%
September	7823	6287	19%
October	6304	4890	22%
Average	6207	4787	22%

The percentage of light lost under glass is shown in the monthly averages given in table XIV, which gave an average throughout the year of 22 percent. The largest loss occurred in the month of December, which was 43 percent., followed by January, 34 percent., and March, 26 percent.; in other words, those months which have the shortest days when the sun is lower in the heavens and when there is more frost, snow and condensed moisture on the roof, show the greatest difference. On the other hand, the least difference is shown in June and July, when the sun is highest and when the light rays strike the glass at more favorable angles. Part of the difference may be due to the reflection of the light from the snow on our recording apparatus, for this reflection would be proportionately greater on the outside exposed tube than on the one exposed inside.

Comparing the average monthly outside records for the whole year it was found, as might be expected, that there is much better light in the summer than in December or January. Neither this ratio nor that between the outside and greenhouse conditions, as shown in the table, is accurate, for the decomposition and consequent loss of efficiency of the chemical substances used to record the light take place more rapidly in intense light. Therefore the actual light of January and June is different from that shown in the table; also the differences between the light out of doors and that under glass are slightly greater than those shown in the tables for any period. These experiments do not show the relative value of east and west and north and south houses from the light standpoint, and to do this would require different conditions. The longest days, with the most intense light, come in June, and it

might be supposed that the average light at this time would be the greatest. This is not always true, however, as cloudy weather is an important factor.

September gave the highest average outdoor light conditions, followed by August and July, although in the greenhouse the highest monthly record was obtained during July and June. It should be pointed out however, that some of the highest daily records were obtained in June. In these particular records, made in 1905, October 5th gave the highest, but June 22d was practically as good, and the days following this date were exceptional for the amount and intensity of light.

Records were also made for six months, from November to April, at corresponding hours to those previously given. These records were made for another purpose, under an ordinary thick walled bell glass 12 inches in diameter and 20 in. high. (See p 13). The bell glass projected vertically through the roof, and the receiving tube was suspended in the middle of the bell glass, its location being such that it received no shadows; and the rays of light, passing through the circular bell glass, were apparently focussed on it. The light conditions under the bell glass proved to be quite different. The records ran higher than those in the greenhouse, while we have average monthly differences of 22 percent. existing between the light in the greenhouse and that out of doors. This difference amounts to only 14 percent. under the bell glass.

The principal facts brought out by the tests are first,—the type of construction affects the light in greenhouses, and second,

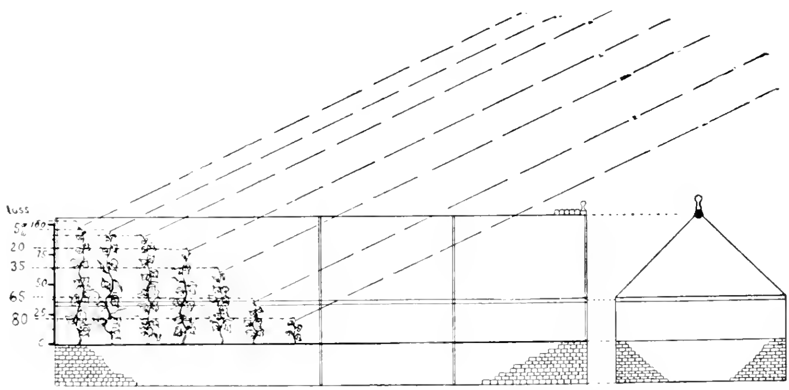

FIG. 5—Showing longitudinal and cross sections of greenhouse with partitions running north and south, and illustrating the effect of poor light conditions. The oblique lines represent the path of the sun's rays.

the curvilinear type appears to be superior to others in this respect, owing to the smaller amount of timber at the eaves to cast

shadows. The tests also show that large glass is superior to small,—that single glazing is better than double, and that the shadows cast by large purlins and heavy rafters affect the light. Tests of this nature might be carried on indefinitely in various types of houses, but this would not be necessary as the light may be quite well determined by anyone familiar with the house.

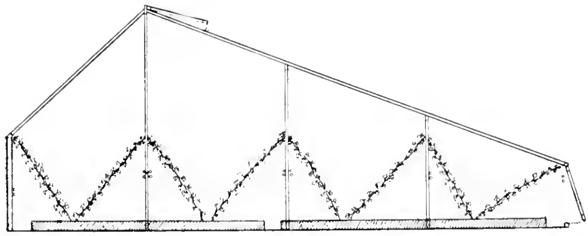

FIG. 6—Showing cross section of an east and west house, about 36 x 200 ft., showing method of growing cucumbers. The light is much superior in a house of this sort.

RELATIVE VALUE OF DIFFERENT TYPES OF HOUSES FROM THE POINT OF VIEW OF LIGHT.

From the results of our experiments with light in greenhouses it is apparent that there are many imperfections in greenhouse construction; but most of them, it must be confessed, are difficult to overcome. This not only holds true in regard to the matter of greenhouse light, but of the ventilation, heat, etc. While great general progress has been made in greenhouse construction during the past twenty-five years, more will doubtless be made in the future for an industry involving so much capital cannot remain stationary. A more even circulation of air and heat, and better light for special crops requiring a great deal, will be had, with other innovations rendering the plant less susceptible to disease.

Since the sun's position in the heavens is continually changing, it is practically impossible to secure the full benefits of the light rays, although by modifications in the structure of the houses it is possible to obtain more light than at present. Some attempt has been made to build high angle roofs for special crops such as roses, but with the increased use of large houses this type of construction has proved expensive and more risky. By far the largest number of houses run east and west, which allows a southern exposure to the roof and side, and from the light point of view this type of house we believe is superior to the north and south house. In the latter type the east side gets the morning light and the west side the afternoon light, while the ends, with the more or less heavy, light obstructing features, are exposed to the south. We are of the opinion that more shade is cast in a house running north and

south than east and west. Most lettuce houses run in this direction, and most cucumber houses run north and south. In these the plants are trained up the sides and along the roof and exclude the light to a great extent from the center of the house. In this case the plants in the east side receive the morning light, and those in the west the afternoon light, and the difference in the yield of crops amounts to considerable owing to the difference in light intensity.

Cucumber houses range from 16 to 25 feet in width. Besides the two rows of plants set near the glass on either side, other rows are planted in the middle and trained vertically, but these rows are so shaded that they receive little light and bear much less fruit than the plants on either side. Sometimes the plants, instead of running parallel with the roof, are trained on trellises shaped like the letter "A", where they do not run so high and receive better light. (See figure 6.) It is believed, however, that better crops can be grown on trellises of this type than where they are trained vertically as in figure 2.

The side hill house with south exposure, where one row is grown higher than another, is admirably adapted for obtaining light, but uniform temperatures are less easily maintained in such a house. Another way to improve the light is to eliminate the shadows cast by heavy framework, particularly the eave plate. What is known as the curvilinear roof construction accomplishes this, and in some other types the shadows are greatly reduced. But some of them are so expensive at present that they are beyond the reach of commercial growers.

A method of construction whose cost would not be prohibitive has a southern exposure of the house built at an angle to furnish the best average light during the season when least light is obtained. Cross sections of such houses are shown in figures 8 and 9. It must be understood, however, that these are mere sketches and are based upon theoretical considerations. The drawing shown in figure 8 shows a house 34 feet wide and 20 feet maximum height. The angle of the south slope is 13 or 14 degrees from the vertical, and as previously stated, represents the best average angle for transmitting sunlight during the months when the light is poor. In a house of this description the ridge would not cast any shadow from October 21st, to February 21st, and the position of the sun at noon at other seasons of the year is shown.

A type of house, involving similar features as in house shown in figure 8, may be seen in figure 9.

In these two types of houses the south slope could be glazed with large glass and the roof and ends with 16 x 24 inch glass. But there are more objectionable features to be met with in this type of house, one of them being the long flat slope to the north which might give some trouble from an accumulation of snow.

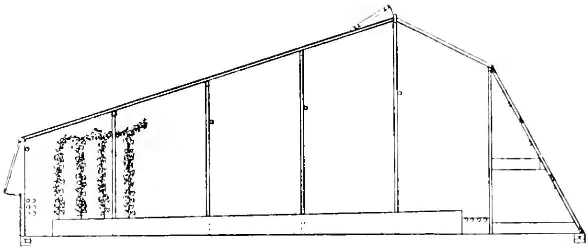

FIG. 7—Showing cross section of a greenhouse used for lettuce and cucumbers. The slanting side towards the right (north) is boarded and used for forcing rhubarb, etc. The cucumber plants are trained vertically.

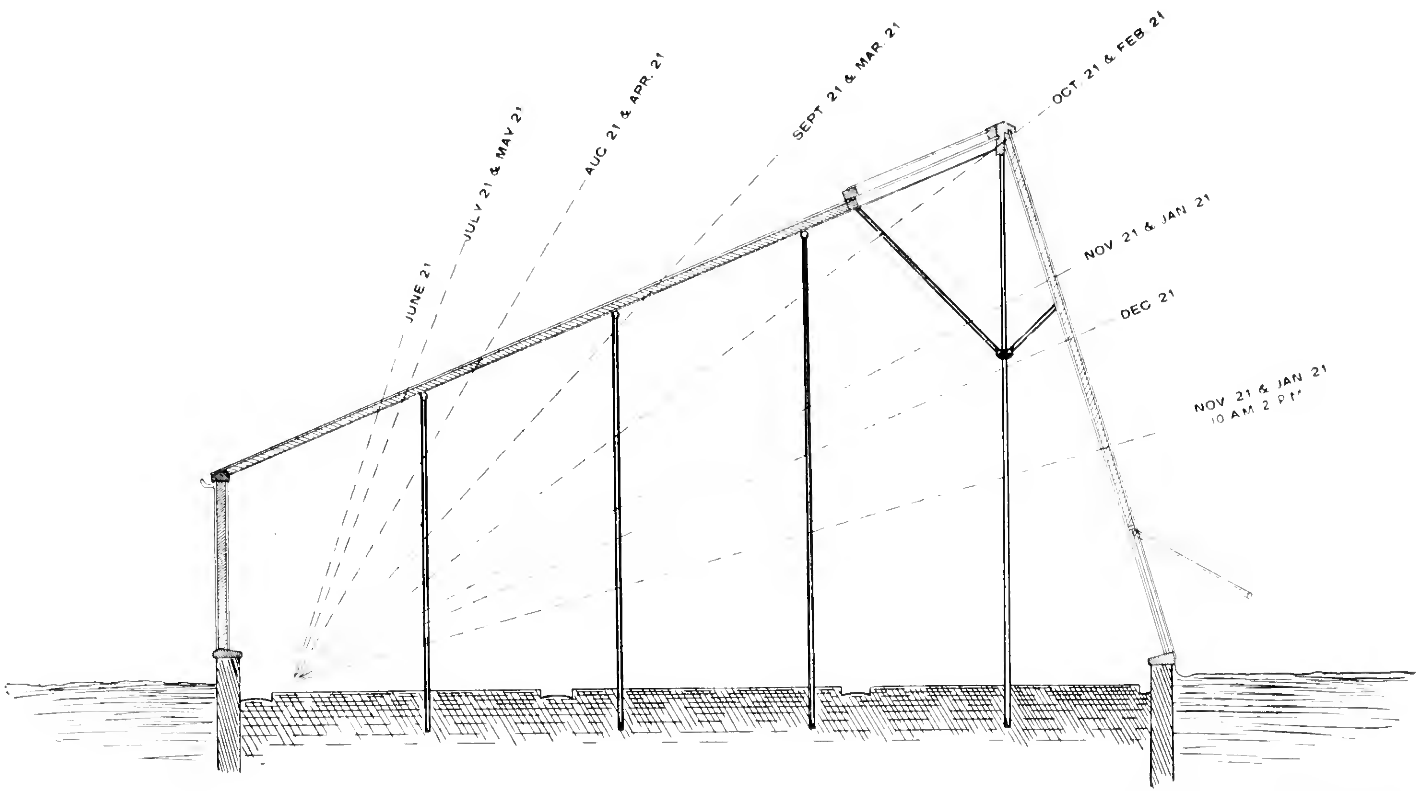

FIG. 8—Showing type of greenhouse constructed for obtaining the maximum amount of light in the short winter days. Dotted lines indicate position of sun at different periods of the day and year.

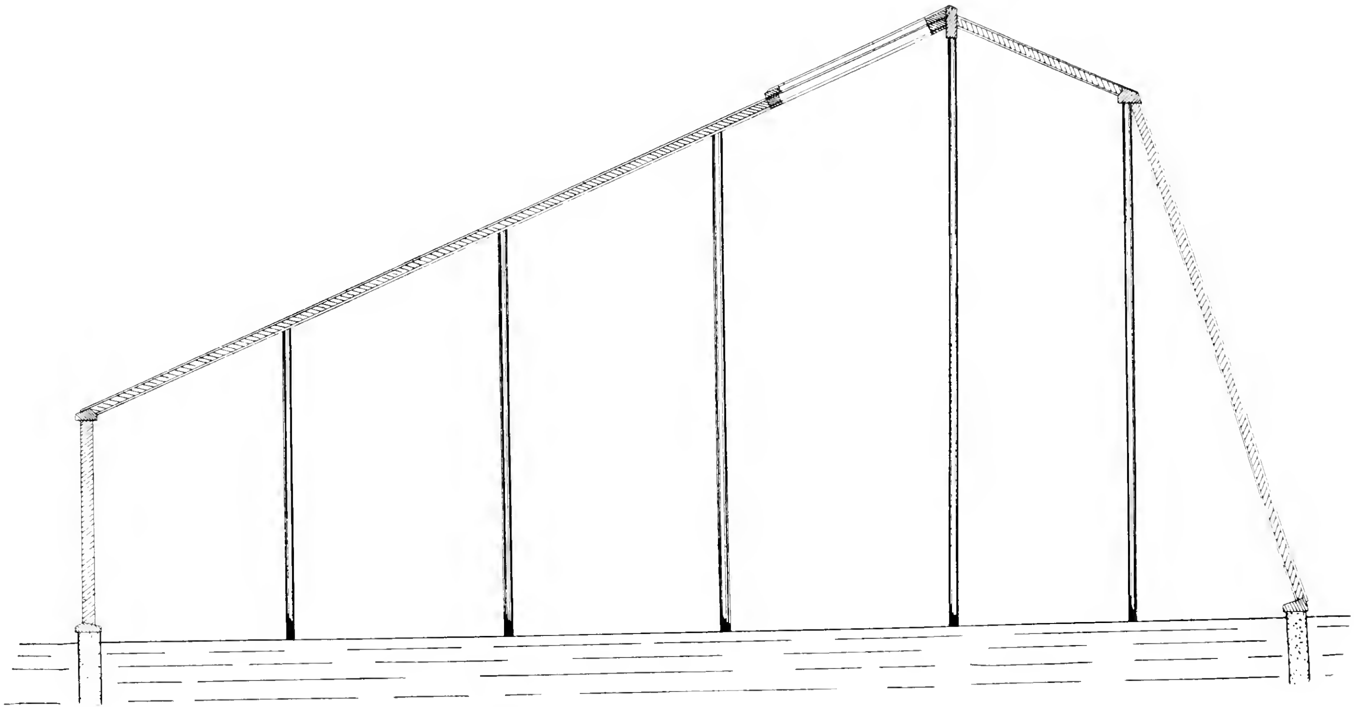

FIG. 9—Showing type of greenhouse constructed to obtain the maximum amount of light in the short winter days. Modification of type shown in Figure 8.

SUMMARY.

The experiments described in this bulletin not only have a bearing on the physiology and pathology of crops, but also on greenhouse construction and management.

Light has an important influence on the configuration of plants. Since most of the plant energy is derived from the air through sunlight. the optimum light conditions are important, and there is a marked difference in plants as regards their light requirements.

During the short winter days many greenhouse crops do not obtain sufficient light, therefore any factor in greenhouse construction which will increase the amount of light is important.

Lack of light is responsible for many greenhouse diseases; on the other hand, too intense light may prove harmful in some instances.

The old type of greenhouse was crude in construction, especially as regards light. The modern tendency is to build larger houses, to use stronger material casting less shade, and larger and better quality glass.

Large houses can be constructed relatively more cheaply and managed more easily because there is a less rapid change of atmospheric conditions, etc. which helps to eliminate many greenhouse troubles.

Morning light is more intense than afternoon light, our experiments showing a difference of 10 percent., and ranging as high as 30 percent. for some months. This difference is not constant from day to day, from month to month or from year to year.

The difference between morning and afternoon light has a practical bearing on the location of greenhouses as regards points of compass.

The location of a house as regards points of the compass has a bearing on the practice of syringing plants, the yield of the crop, and to a certain extent on fungous infection.

To obtain the best results in a house running east and west, the house should be from 15 to 30 degrees north of east. This enables the plant to take advantage of the more intense morning light and the crop can be syringed with less danger from infection.

The difference in morning and afternoon light may be shown by various chemical methods, as well as by the growth of trees. and of crops of cucumbers in north and south houses. Other things being equal, a crop will show greater development on an east than a west exposure.

There is considerable difference in the light transmitting properties of glass. Second quality, double thick greenhouse glass transmits 18 percent. less than No. 1, double thick, and the third quality double thick transmits 33 percent. less than first quality and 15 percent. less than second quality.

An irregular surface, bubbles, etc. in glass act as lenses and affect the even diffusion of light.

New glass is slightly superior to used glass. The deterioration from dirt and other factors is much less than 1 percent. per annum.

The more nearly the angle of the roof coincides with the right angle of the sun's rays the more light is transmitted.

Relatively steep roofs are superior to flat roofs for transmitting light. Records made in February show that a house with a roof angle of 46° gave 18 percent. more light than one with a 32° angle roof.

The reflection of light from surfaces varies greatly. In our experiments we found aluminium bronze to constitute the best reflector of light.

The practice of lapping glass causes some loss of light, an average of 11 percent. in our tests.

There appear to be no important differences in the light in a greenhouse at different distances from the glass, practically the same light being obtained at 5 feet as at 30 feet. The light to be had directly under the glass, however, varies in intensity owing to the irregularity of the surface.

The loss of light from glass may vary from 13 to 36 percent. or more, depending on the quality and condition of the glass, and many other factors.

Double glazed houses are much inferior to those glazed with a single layer of glass.

BULLETIN No. 145 SEPTEMBER, 1913

MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION

RECORD OF

The Station Dairy Herd

AND

The Cost of Milk Production.

By J. B. LINDSEY.

This bulletin contains a record of the amount and cost of the food consumed and of the milk produced by each cow in the station herd from 1896 through 1911.

The estimated cost of housing and caring for the cow and her product is also stated, which added to the food cost, shows a total average yearly cost of $146.04 per cow. The average yearly production was 6036 pounds, and the estimated cost of a quart of milk averaging 5 percent of fat is shown to be 5.45 cents. Data from other sources are also cited. The amount of dry and digestible matter required to produce milk and milk ingredients is stated and indicates that the largest producers required the smallest amount of food to make a definite amount of product. Large cows produced milk rather more economically than the smaller ones.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

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AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

* On leave.

Record of the Station Dairy Herd

AND

THE COST OF MILK PRODUCTION.

By J. B. Lindsey.*

FOREWORD.

Since 1896 the experiment station has kept a herd of from six to twelve cows primarily for the purpose of studying the relative values of coarse and of concentrated feedstuffs upon growth and milk production, and also for investigating the effect of the different groups of nutrients upon the chemical character of the milk fat. With such objects in view it has, of course, not been possible to ascertain the complete cost of milk production. An exact record, however, has been kept of the food consumed by each animal in the herd and of the composition and amount of the milk produced. It is believed that the data accumulated are of sufficient importance to warrant publication.

ERRATA.

After this bulletin was printed, one mistake in copying and a few small errors were discovered due to faulty work in mechanical adding. Though the consequent mistakes are not sufficient to in the least invalidate conclusions, they are here noted :

Page 6, Cow Blossom, 1899, column 1, in place of 6631, read 2211.

Page 27, Table IX, last column ; in place of 11.49, read 15.06.

Page 9, Table II, errors in calculation corrected make total grain consumed 264,988 pounds ; corn stover, 37,442 pounds ; molasses, 2,048 pounds ; oats, 1,070 pounds. Total food cost should be $11,690.16 in place of $11,794.80 and food cost per cow in Table III should be 89.24 in place of 90.04 ; hence the food cost of one quart of milk (page 17) should be 3.33 cents in place of 3.35

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

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Joseph B. Lindsey, Ph. D.,	*Vice Director and Chemist.*
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Carleton P. Jones, M. S	

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Since 1896 the experiment station has kept a herd of from six to twelve cows primarily for the purpose of studying the relative values of coarse and of concentrated feedstuffs upon growth and milk production, and also for investigating the effect of the different groups of nutrients upon the chemical character of the milk fat. With such objects in view it has, of course, not been possible to ascertain the complete cost of milk production. An exact record, however, has been kept of the food consumed by each animal in the herd and of the composition and amount of the milk produced. It is believed that the data accumulated are of sufficient importance to warrant publication.

HISTORY OF THE HERD.

The original herd was purchased of farmers in the vicinity. In case an animal did not serve its purpose it was replaced by the purchase of a mature cow fresh in milk. The animals were mostly grade Jerseys, the prevailing breed in this locality at the time. In 1903 the station began to keep up its herd by the use of a pure bred Jersey bull and a number of pure bred Jersey heifers were also purchased. The addition, by breeding, of a few grade Holsteins and Ayrshires has lately been made. Until 1905 practically all of the

*The complete tabulation of the individual cow records was made by Mr. P. H. Smith to whom due credit should be given. The data were arranged for publication and the bulletin prepared by Dr. Lindsey.

cows were mature and in condition to make the largest returns for a number of years. Later, with the frequent addition of heifers with first calves, the average milk yield was naturally somewhat lessened. It was not considered advisable for the station to keep a pure bred herd for the reason that it was necessary to change animals frequently. On the whole the cows bred at the station proved more satisfactory than those purchased, although some home bred heifers did not show improvement over their dams and were discarded. The cows weighed from 650 to 1100 pounds; the average weight approximated 900 pounds.

The herd has been comparatively free from disease. Two slight outbreaks of abortion have occured, introduced unquestionably from a purchased animal or by the use of an outside bull. One outbreak of tuberculosis was experienced some nine years ago due to the accidental introduction of a diseased cow. Four animals became infected and when slaughtered proved to be slightly diseased. The present herd of twelve milking cows and several head of young stock were tested with tuberculin during the winter of 1913 without reaction. We have had practically no trouble in keeping out tuberculosis when only occasional tuberculin-tested animals were purchased.

METHOD OF FEEDING AND CARE.

The cows have been kept in separate stalls, water being constantly before them by the aid of a self-watering device. They have been fed twice daily, both the roughage and grain as a rule being given them after milking in the morning and before milking in the evening. Feeds having a pronounced flavor or odor are fed after milking. Feeding in the middle of the day is considered unnecessary and expensive. After the consumption of the feed, the cow is perfectly contented to lie down and chew her cud. Two ounces of salt mixed with the grain are fed daily. During the winter the animals are turned into the barnyard daily for from three to six hours whenever the weather conditions are suitable. In the summer months they are in the same barnyard for a much longer period daily, and are also turned out at night after they have eaten. Only the dry cows have been sent to pasture. The cows are bred to calve in the early autumn if possible. In summer they are fed grain and hay and partially soiled with some 50 pounds daily of such green

feeds as clover, alfalfa, peas and oats, barnyard millet and corn fodder.

The manure is removed twice daily and the cows carded and brushed once a day. Once during the year the barn is thoroughly brushed out and then sprayed with warm water to which is added as much cresol as it will take up (few per cent)*. Stalls and gutters are sprayed at more frequent intervals. Sawdust or baled shavings are used as bedding in sufficient amounts to keep the animals clean. The barn wings in which the animals are housed are heated in winter to a temperature of 50 degrees by steam from the college central heating plant. The barn is in a very exposed place and if this were not done our opportunity for experimentation would be seriously interfered with. Care is taken to keep the barn well ventilated by means of windows, some of which are made to open at the top and bottom and others are hinged at the bottom to open inward. (Sherringham valve).

KEEPING RECORDS.

The grain and hay are weighed out daily and the weights recorded on prepared blanks. The milk produced at each milking is also weighed on a Chatillon spring balance and the result immediately set down on a record blank. During parts of the year composite samples of each cow's milk are made weekly, and when the animals are not used in an experiment a five-day composite sample is taken monthly; all samples are tested for fat and solids.

It will thus be seen that very complete records have been kept of the food consumed and the milk produced. No effort has been made to record the cost of caring for the animals and their product.

*Sulpho-naphthol is also satisfactory.

TABLE I.

Total Feeds Consumed, 1896—1911.

Name.	Year.	Grain, lbs.	Hay and Rowen, lbs.	Silage, lbs.	Green Feed, lbs.	Dried Beet Pulp, lbs.	Corn Stover, lbs.	Miscellaneous, lbs.		Pasture, Days.
Red........	1896	2221	2398	4600	1730	1155	—	1258[1]	—	70
Bessie......	1896	2118	1654	7255	3180	—	—	724[1]	90[2]	56
	1897	2843	3785	6340	4955	—	—	—	—	—
	1898	2258	5565	2220	4460	—	—	—	—	—
	1899	1841	5260	2956	4985	—	—	—	—	—
	1900	2863	5038	2300	6663	—	85	—	—	—
Beauty	1896	2201	2627	6120	1742	1185	—	1284[1]	90[2]	52
	1897	2099	4507	6080	1420	—	—	—	—	33
	1898	2357	6002	2569	4415	—	—	—	—	—
	1899	2182	5404	2953	2809	—	—	—	—	34
Spot	1896	2224	2410	5206	1860	1170	—	1217[1]	—	49
Jennie......	1897	2339	3728	4620	2580	—	—	—	—	33
	1898	2032	4825	2150	3720	—	—	—	—	—
	1899	2104	4907	2920	1525	—	—	—	—	65
	1900	1694	3979	2300	1991	—	199	—	—	99
Mary.......	1897	2448	4130	4640	5005	—	—	—	—	—
	1898	2432	5284	2150	3920	—	—	—	—	—
	1899	1807	5210	2991	5045	—	—	—	—	—
Black	1897	1779	2498	3010	5270	—	—	—	—	—
Guernsey ..	1897	2053	2696	3625	5360	—	—	—	—	—
	1898	2265	5272	2080	3800	—	90	—	—	—
	1899	2500	4368	2960	5499	—	—	—	—	—
Midget	1897	2736	3100	4805	4920	—	—	—	—	—
	1898	2230	4698	1811	3340	—	—	—	—	—
	1899	2077	4538	2728	2345	—	—	—	—	36
Mildred	1897	2610	2933	6552	5225	—	—	—	—	—
	1898	2251	4756	2045	3915	—	—	—	—	—
	1899	1865	4445	2689	2999	—	—	—	—	30
	1900	2255	4078	2110	2839	—	168	—	—	57
Nina	1898	2043	4299	2022	1930	—	—	—	—	69
	1899	2288	4505	2571	2945	—	—	—	—	54
	1900	2166	3166	1923	3174	—	159	—	—	76
Alice.......	1898	2260	5527	1721	3280	—	—	—	—	—
Blossom....	1898	2255	5151	2245	3860	—	—	—	—	—
	1899	6631	4705	2782	4420	—	—	—	—	13
Sadie	1898	1844	3960	1773	1448	—	—	—	—	76
	1899	2260	4659	2731	2135	—	—	—	—	36
	1900	1891	3688	2064	1843	—	219	—	—	88
Susie.......	1898	2562	5228	2550	3850	—	—	—	—	—
Pearl.......	1900	2115	4370	2252	3282	—	276	—	—	82
	1901	3003	7169	—	6404	—	—	—	—	—
Dora	1901	1838	5151	—	3753	—	—	—	—	73
	1902	1629	5041	40	3750	—	—	—	—	68
	1903	2024	4055	3241	1407	—	—	—	—	72
	1904	1713	4511	3276	1479	—	—	195[3]	—	54
	1905	2148	3727	3438	2716	—	—	—	—	59
Ruth	1901	1918	4948	—	3138	—	—	—	—	77
Brighty	1902	1759	4907	40	3345	—	—	—	—	71

[1] Cottonseed feed. [2] Cotton hulls. [3] Molasses.

TABLE I (Continued).

Name.	Year.	Grain, lbs.	Hay and Rowen, lbs.	Silage, lbs.	Green Feed, lbs.	Dried Beet Pulp, lbs.	Corn Stover, lbs.	Miscellaneous, lbs.	Miscellaneous, lbs. (cont.)	Pasture, Days.
	1903	1940	3917	3595	1032	—	—	—	—	72
	1904	1807	4333	4064	1310	—	994	104[1]	—	58
Linnie......	1902	1977	5180	12	999	—	400	1135[2]	—	45
	1903	1034	4238	3324	1946	—	—	—	—	75
May	1902	1997	5979	40	3990	—	—	—	—	64
	1903	2157	4964	3874	1596	—	—	—	—	72
	1904	1958	4941	4154	4910	—	1372	205[1]	—	—
	1905	1490	4313	3032	3411	—	—	193[1]	—	66
	1906	1891	4069	2885	1560	—	—	36[1]	—	88
Red II	1902	1881	5518	40	4721	—	585	1945[2]	—	14
	1903	2215	3963	3055	7121	—	197	—	—	11
	1904	2209	5519	4691	4560	—	1184	95[1]	—	—
	1905	2356	5027	3977	4548	—	988	—	—	37
	1906	2054	5015	3510	902	—	1277	171[1]	—	57
Blanche	1901	2887	6717	—	6063	—	—	—	—	—
	1902	1912	5869	37	3104	—	—	—	—	81
	1903	2269	5047	3798	1569	—	—	—	—	72
	1904	2081	5143	4722	1310	—	1264	55[1]	—	58
	1905	2207	4756	3485	3168	—	786	—	—	48
	1906	1860	4504	3488	824	—	—	—	—	101
Rhoda	1902	2311	4820	40	3660	—	—	—	—	68
	1903	1641	3459	3055	165	—	—	—	—	112
Daisy	1903	1948	4407	3485	1846	—	—	—	—	55
	1904	1849	4900	3276	2432	—	—	180[1]	—	41
	1905	1903	4674	2182	1694	—	—	216[1]	—	55
	1906	1921	4219	2325	1634	—	—	—	—	77
	1907	1864	4882	—	3355	75	—	—	—	70
	1908	1512	4494	—	—	—	—	—	—	65
	1909	1715	4797	—	355	—	—	—	—	111
Doliska	1903	1980	4157	2898	1564	—	65	—	—	75
Fancy	1905	1889	4124	3854	1912	—	—	193[1]	—	57
	1906	2534	4058	2325	1559	—	—	38[1]	—	66
	1907	1938	4707	—	1200	75	—	—	—	95
Gladys	1905	1547	3697	3311	3893	—	831	—	—	—
	1906	2016	4207	2258	4150	—	1485	—	—	—
	1907	2063	6598	—	635	75	—	—	—	75
	1908	2261	5287	—	5630	—	620	34[1]	—	—
	1909	2045	5090	—	2947	—	—	—	—	49
	1910	1747	5701	—	3661	619	1213	—	—	—
	1911	1598	5672	—	3320	—	985	319[3]	98[4]	—
May Rio ...	1905	1602	3405	3751	3051	—	680	—	—	33
	1906	1941	4105	2330	1234	—	—	—	—	59
	1907	1720	4387	—	2265	75	—	—	—	87
	1908	2111	5219	—	3324	—	—	—	—	51
	1909	2113	5136	—	4375	—	175	—	—	—
	1910	1836	5979	—	4507	312	1360	124[5]	—	—
Molly	1905	1512	4311	1992	2698	—	455	308[1]	—	79
Samantha ..	1906	2092	5315	2325	2276	—	—	25[1]	—	46
	1907	2280	6040	—	2475	75	—	—	—	55

[1] Molasses. [2] Apple Pomace. [3] Cocoanut meal. [4] Cocoa hulls. [5] Oats.

TABLE I (Continued).

Name.	Year.	Grain, lbs.	Hay and Rowen, lbs.	Silage, lbs.	Green Feed, lbs.	Dried Beet Pulp, lbs.	Corn Stover, lbs.	Miscellaneous, lbs.		Pasture, Days.
	1908	2240	5829	—	3590	—	—	—	—	43
	1909	2252	5491	—	3225	—	240	—	—	61
	1910	2035	5854	—	1650	45	1531	400[4]	—	53
	1911	2120	7222	—	2982	—	1244	325[2]	42[3]	10
Betty	1906	1636	4609	1548	3885	—	1225	—	—	—
	1907	1977	6507	—	1955	75	—	—	—	38
	1908	2159	6182	—	4684	—	—	—	—	—
	1909	2212	5409	—	2751	—	175	—	—	49
	1910	1744	5463	—	3086	427	881	920[1]	—	16
	1911	1966	6510	—	3332	—	1214	324[2]	82[3]	—
Maude	1906	1618	4019	2288	4485	—	420	—	—	—
Cecile	1907	2075	5460	—	2789	—	—	—	—	—
	1908	2242	5634	—	4030	60	—	—	—	—
	1909	2311	5035	—	5555	—	373	—	—	—
	1910	1561	5897	—	3246	706	1350	30[2]	—	—
	1911	2037	6027	—	2423	—	—	172[2]	40[3]	40
Chub	1908	784	6131	—	2260	—	—	—	—	62
Minnie	1908	867	6325	—	1820	—	—	—	—	62
	1909	1891	4872	—	1220	—	—	—	—	69
Mary.......	1908	2315	5244	—	1710	—	—	—	—	—
Red III	1908	2288	4873	—	5891	—	—	—	—	—
	1909	2204	5238	—	2921	—	200	—	—	37
	1910	1875	5651	—	2099	3	803	29[2]	1250[1] 330[4]	35
	1911	1864	6280	—	1300	—	1040	172[2]	101[3]	62
Betty II....	1909	2357	4780	—	4604	—	379	—	—	—
	1910	2049	5984	—	3312	309	1317	31[2]	—	—
	1911	2295	5514	—	2417	—	—	172[2]	42[3]	57
Amy	1910	1347	4185	—	1391	417	1072	—	—	49
	1911	1527	5260	—	3276	—	1344	218[2]	39[3]	—
Fancy II...	1910	1394	4056	—	1913	250	1070	25[2]	—	47
	1911	1628	4480	—	2360	—	—	131[2]	40[3]	55
Ida	1910	1438	4575	—	1590	171	1215	26[2]	216[4]	53
	1911	1584	6218	—	3291	—	1112	130[2]	42[3]	—
Fancy III ..	1911	1914	4887	—	2738	—	1125	95[3]	—	—

[1] Potatoes. [2] Cocoanut meal. [3] Cocoa hulls. [4] Oats.

TABLE II.

Total Cost of Feeds Consumed.*

Feedstuff.	Amount Consumed. lbs.	Price Per Ton.	Total Cost.
Grain	272,018	$32.00	$4,352.29
Hay and Rowen	631,422	18.00	5,682.80
Silage	238,470	4.50	536.56
Green Feed	395,918	3.50	692.86
Beets	7,279	6.00	21.84
Cotton Hulls	180	8.00	0.72
Corn Stover	36,479	7.00	127.68
Apple Pomace	3,080	4.00	6.16
Molasses	2,347	25.00	29.34
Potatoes	2,170	10.00	10.85
Cocoanut Meal	2,104	26.00	27.35
Cottonseed Feed	4,483	20.00	44.83
Oats	524	30.00	7.86
Cocoa Hulls	621	15.00	4.66
Pasture (days)	4,980	5c per day.†	249.00
			$11,794.80

*Since the above was compiled, grain and hay have advanced in price.
† For dry cows; may be too low for some localities.

Instead of allowing the market prices prevailing in different years for grain, hay and other feedstuffs, it was thought it would be more instructive to figure the cost at the prices prevailing during the past four or five years. The price of grain is based on ton lots for cash delivered at the feeding barn. Hay is supposed to have been grown upon the farm and has been estimated at the market value in the mow. It is believed that the prices are fairly representative. Some may consider the estimated cost per ton of the silage too high. In the station herd no silage has been fed since 1906. During the summer when the cows were in milk they were fed on soiling crops, hay and grain. This method naturally increased the feed cost somewhat.

As a summary of Tables I and II we have the following:

TABLE III.

Average Cost of Grain and Roughage Per Cow.

Number Yearly Records	Grain		Roughage		Total Food Cost per Cow	Percentage Cost of Grain	Percentage Cost of Roughage
	Total Cost	Av. per Cow	Total Cost	Av. per Cow			
131	$4416.84	$33.72	$7377.96	$56.32	$90.04	37.4	62.6

It will be seen that the average cost of food consumed per cow was $90.04 and that the cost of grain was 37.4 percent of the total cost.

TABLE IV.

Estimated Expenses Other Than Cost of Feed. (Fixed Charges). Basis 20 Cows.

1.	Barn for housing cow and feed, (per cow), .	$75.00*	
	Interest, taxes, depreciation, repairs and insurance, 10 per cent, . .	—	$ 7.50
2.	Value of cow, ...	75.00†	
	Interest and taxes, 7 percent, . .	—	5.25
	Depreciation, 15 percent, . . .	—	11.25

*It is recognized that modern dairy barns, especially if built partly of cement, would cost very much more. The above figure is intended more as an average for existing buildings.

†Large heavy milking cows, if purchased fresh at market centers, would cost from $25 to $35 more.

3.	Value of barn tools, dairy implements, and the like, per cow, ...	7.62	
	Interest and depreciation, 15 percent,	—	1.15
4.	Value of perishable tools and supplies, per cow, (cards, brushes, record sheets, soap, salt, ice, bedding, veterinary service, etc.)	—	9.00
5.	Cost of pure bred bull, per cow, . .	—	4.00
6.	Care of cow and milk for one year, . .	—	35.00
			$73.15

It must be borne in mind that the above figures are *estimates* only. Large items such as cream separators, steam boilers, power cutters and the like have not been included in the estimates. In some cases the estimate may be too high; in others it is doubtful if it meets the actual expenses incurred. Much depends upon the kind of barn and equipment and whether the owner assists and exercises careful supervision in caring for the stock.

Various estimates have been made of the cost of caring for the cow and milk for one year, varying from $18 to $45. It is felt that $35 is not excessive considering the present cost of labor and the difficulty of securing reliable help. If dairymen will keep reasonably careful accounts of all expenses including interest on the investment, yearly losses, depreciation on buildings, tools and stock, and actual cost of labor both in caring for the cow and her product, they will see that it amounts to a considerable sum for each cow kept. In making the above estimate the intention has been to provide sufficient tools and help to keep the barn and cows in respectable condition and to produce a reasonably clean milk.

Credit for Manure and Calf.

3 cords of manure at $5.00 a cord at the barn, . . .	$15.00
1 calf yearly, ...	2.00
	$17.00

It is very difficult to put a commercial value on the manure excreted by the animal yearly so much depends on how it is cared for, etc. Considerable is also voided in the pasture; this has not as great a

value as that collected at the barn. A credit of three cords per cow yearly, equal in commercial value to $15.00, is as high an average figure as one is justified in giving it. It is doubtful if the average calf from a grade herd will bring over $2.00. Deducting $17.00 from the fixed charge of $73.15 one has substantially $56.00 as the net fixed charge* to be added to the food cost (15.3 cents per day).

*Trueman of the Connecticut (Storrs) Station gives $50. as the net fixed charge after allowing $15. for manure and calf while Minkler of the New Jersey Station places the amount at $70.22 without making the allowance. If $15. should be deducted, the net charge would be $55.22. Detailed data of these two investigations is given elsewhere in this bulletin.

TABLE V.

Yield of Milk and Milk Ingredients—Complete Yearly Records.

Name.	Year.	Days in Milk.	Milk, lbs.	Total Solids, Per cent.	Total Solids, lbs.	Fat, Per cent.	Fat, lbs.	Butter, lbs.
Red........	1896	290	6500.2	12.91	832.5	4.26	273.9	319.5
Bessie......	1896	300	7015.8	13.32	933.1	4.61	319.9	373.3
	1897	365	8322.2	13.53	1119.1	4.61	378.9	442.1
	1898	289	7311.0	14.09	1012.9	4.87	350.3	408.7
	1899	259	6975.3	14.09	982.8	4.87	339.7	396.3
	1900	365	10738.0	13.65	1465.7	4.70	504.7	588.8
Beauty	1896	296	6218.7	14.58	903.8	5.19	319.9	373.2
	1897	295	5749.8	14.61	797.5	5.18	296.3	345.7
	1898	346	6578.9	15.14	986.5	5.31	350.5	408.9
	1899	315	6813.4	15.14	1031.5	5.31	361.8	422.1
Spot	1896	309	5802.9	14.43	831.4	5.02	287.5	335.4
Jennie......	1897	271	6071.8	15.48	939.6	5.68	346.6	404.3
	1898	297	6228.4	15.68	963.1	5.68	350.3	408.7
	1899	286	7128.2	15.68	1117.7	5.68	404.9	472.4
	1900	237	5929.6	15.58	923.8	5.68	336.8	392.9
Mary.......	1897	299	5940.3	14.24	839.1	4.89	286.1	333.8
	1898	304	7401.6	14.09	1037.2	4.88	355.7	414.9
	1899	243	6729.1	14.09	948.1	4.88	328.4	383.1
Black	1897	288	5095.1	14.70	721.8	5.28	250.1	291.7
Guernsey...	1897	275	5627.3	14.14	791.6	5.07	282.8	329.9
	1898	321	5203.7	15.09	785.9	5.67	294.5	343.6
	1899	313	7996.3	15.09	1206.6	5.67	453.4	528.9
Midget	1897	334	7022.8	13.73	956.5	4.43	306.8	357.9
	1898	273	5736.7	14.39	812.2	4.62	264.5	308.6
	1899	281	7398.9	14.39	1064.7	4.62	341.8	398.8
Mildred	1897	317	7068.6	12.70	893.4	3.87	270.5	315.6
	1898	289	6441.6	12.81	822.1	4.06	260.4	303.8
	1899	238	4643.9	12.81	594.9	4.06	188.5	220.0
	1900	283	8119.2	12.76	1036.0	3.97	322.3	376.1
Nina	1898	280	5766.7	13.39	762.5	4.22	240.0	280.0
	1899	302	7390.6	13.39	989.6	4.22	311.9	363.9
	1900	261	6003.3	13.39	803.8	4.15	249.1	290.7
Alice.......	1897	340	6537.8	13.94	910.9	4.62	302.7	353.1
Blossom....	1898	302	6266.9	14.60	912.1	5.02	314.5	366.9
	1899	347	6734.9	14.60	983.3	5.02	338.1	394.4
Sadie	1898	265	4980.2	14.14	703.2	5.04	249.7	291.3
	1899	318	6772.8	14.14	957.7	5.04	341.4	398.2
	1900	242	5825.0	14.14	823.7	5.04	293.6	342.5
Susie.......	1898	365	6634.5	15.92	1047.4	6.09	399.3	465.9
Pearl.......	1900	258	6519.2	14.51	945.9	5.67	369.6	431.3
	1901	365	7918.2	14.51	1148.9	5.67	448.9	523.8
Dora	1901	290	6528.3	14.21	1069.8	4.92	370.4	431.1
	1902	282	6194.8	13.73	850.6	4.71	291.8	340.4
	1903	280	6529.5	13.79	897.9	4.86	315.9	368.5
	1904	284	6165.7	13.80	850.5	4.75	333.7	389.4
	1905	303	6207.1	13.46	829.7	4.47	271.7	317.0

TABLE V (Continued).

Name.	Year.	Days in Milk.	Milk, lbs.	Total Solids, Per cent.	Total Solids, lbs.	Fat, Per cent.	Fat, lbs.	Butter, lbs.
Ruth	1901	276	5074.7	—	—	4.04	205.0	239.2
Brighty	1902	282	5557.6	15.42	856.9	5.98	332.3	387.7
	1903	280	5828.9	15.09	870.5	5.89	342.1	399.1
	1904	296	5718.8	15.37	871.6	6.03	340.3	397.0
Linnie......	1902	296	6196.9	14.13	875.6	5.23	324.1	378.1
	1903	277	6790.6	14.18	958.9	5.26	353.9	412.8
May	1902	285	6457.1	15.02	969.9	5.38	347.4	405.3
	1903	281	6343.2	14.86	939.3	5.29	334.6	390.4
	1904	366	5931.3	14.92	881.8	5.46	318.1	371.1
	1905	266	4740.3	14.95	694.4	5.28	237.8	277.5
	1906	269	5056.5	14.89	753.6	5.26	264.4	308.4
Red II	1902	254	4760.4	12.56	597.9	4.13	196.6	229.4
	1903	276	9053.4	12.87	1166.1	4.24	377.1	440.0
	1904	290	8517.1	12.40	1049.7	4.17	346.7	404.5
	1905	286	7919.2	12.63	985.7	4.01	312.2	364.2
	1906	290	7826.6	12.92	996.1	4.22	325.1	379.2
Rhoda	1902	282	5844.5	13.79	806.0	4.75	277.6	323.9
	1903	253	4977.2	13.79	679.1	4.78	232.9	271.7
Doliska	1903	277	6837.1	12.58	856.8	3.78	257.2	300.0
Daisy	1903	298	5636.0	15.45	864.9	5.84	325.7	380.0
	1904	306	5986.3	15.13	902.4	5.54	328.3	383.0
	1905	303	4956.4	15.39	756.2	5.58	271.0	316.2
	1906	269	4412.8	15.48	679.0	5.76	253.0	295.2
	1907	267	5333.0	15.51	825.8	5.82	309.4	361.0
	1908	221	3940.1	15.18	594.6	5.79	227.5	265.4
	1909	235	4665.5	14.94	685.8	5.06	266.2	310.5
Blanche	1901	365	7528.3	14.21	1069.8	4.92	370.4	432.1
	1902	266	5700.1	14.21	809.9	4.92	280.4	327.2
	1903	277	6999.1	14.40	1006.1	5.03	351.4	410.0
	1904	295	7101.5	14.28	1008.7	5.00	366.3	427.3
	1905	289	5260.3	14.24	747.9	4.76	250.9	292.7
	1906	276	4451.8	14.53	644.9	4.98	220.8	257.5
Fancy	1905	302	5961.5	13.84	815.4	4.60	266.8	311.2
	1906	283	5193.9	13.72	713.2	4.65	241.6	281.9
	1907	258	6640.8	14.02	921.4	4.83	316.6	369.4
Molly	1905	277	4622.3	15.00	690.5	5.08	232.0	270.6
Gladys	1905	303	4215.6	14.78	614.2	5.38	224.4	261.8
	1906	306	5387.7	14.92	786.6	5.56	289.7	338.1
	1907	278	6142.2	14.46	891.2	5.28	327.1	381.6
	1908	292	5279.6	14.32	760.8	5.36	286.3	333.7
	1909	281	6028.6	14.14	852.1	5.34	321.6	375.2
	1910	357	6500.3	14.52	946.3	5.55	363.1	423.6
	1911	288	4498.6	13.95	637.4	5.52	252.0	294.1
May Rio ...	1905	299	4056.9	14.68	676.7	5.40	244.8	285.6
	1906	297	5160.4	14.88	764.4	5.72	293.2	342.1
	1907	245	5027.1	15.09	752.7	5.84	291.5	340.1
	1908	281	5561.8	14.91	822.8	5.97	333.1	388.6
	1909	302	5515.5	14.66	803.9	5.89	325.4	379.7
	1910	349	6524.9	15.06	967.6	6.05	387.9	452.6
Samantha ..	1906	310	6042.6	14.94	902.2	5.44	328.9	383.8

TABLE V (Continued).

NAME.	Year	Days in Milk.	Milk, lbs.	Total Solids, Per cent.	Total Solids, lbs.	Fat, Per cent.	Fat, lbs.	Butter, lbs.
	1907	298	6456.8	15.00	1046.2	5.53	384.6	448.7
	1908	293	6197.5	15.13	940.2	5.78	360.6	420.7
	1909	293	6311.5	15.00	936.4	5.99	378.4	441.5
	1910	298	6801.8	14.99	1021.5	5.27	401.3	468.2
	1911	283	6550.6	15.30	1003.1	6.20	407.7	475.6
Betty	1906	332	4784.5	14.74	692.9	5.20	241.1	281.3
	1907	289	5790.2	14.17	819.2	4.94	285.8	333.4
	1908	286	6123.3	14.47	884.8	5.21	318.3	371.3
	1909	285	5530.2	14.31	791.4	5.21	289.9	338.2
	1910	301	6004.2	14.46	865.3	5.15	309.8	361.5
	1911	285	5969.3	14.31	853.3	5.14	307.2	358.4
Maude	1906	318	4002.6	15.13	603.2	5.61	220.1	256.8
Cecile	1907	304	5730.7	14.48	813.9	4.95	277.4	323.6
	1908	285	6176.5	14.22	877.3	5.10	315.2	367.7
	1909	298	5304.0	13.08	755.8	5.36	281.2	328.2
	1910	308	6854.6	14.46	989.6	5.23	358.7	418.4
	1911	284	6158.4	14.21	875.7	4.98	308.8	360.3
Chub.......	1908	292	4707.3	12.42	583.2	3.85	180.3	210.3
Minnie	1908	280	5010.5	12.79	589.1	4.08	187.8	219.1
	1909	277	5457.2	13.18	715.8	4.26	229.7	268.0
Mary.......	1908	291	6688.5	13.56	902.2	4.44	294.2	343.3
Red III....	1908	280	5010.6	13.38	665.5	5.02	258.9	302.1
	1909	290	6207.1	13.42	829.0	5.20	321.3	374.9
	1910	299	6490.8	14.01	889.4	5.30	337.4	393.6
	1911	283	6900.5	13.67	940.7	5.33	366.5	427.6
Betty II....	1909	320	5158.3	13.86	696.1	4.85	274.3	320.0
	1910	300	7404.8	13.66	1003.6	4.76	347.9	405.9
	1911	272	6715.5	13.87	934.9	4.91	333.0	388.5
Amy	1910	314	4472.8	14.88	665.1	5.70	255.4	262.9
	1911	294	4177.3	14.76	615.4	5.73	239.9	279.9
Fancy II. ..	1910	308	4403.8	13.80	603.8	4.90	213.7	249.4
	1911	286	4897.4	13.88	676.4	5.09	247.8	289.1
Ida	1910	285	3940.6	16.04	632.5	6.64	261.2	304.7
	1911	286	4155.0	16.12	656.3	6.83	277.2	323.4
Fancy III..	1911	287	5164.1	13.14	675.5	4.70	239.5	279.5

The chief feature to be noted in studying the above records is the fluctuation in the amount of milk produced by the same cow in different years. A high production one year is likely to be followed by a low production the following year. This is quite often due to different intervals of calving. Some cows, on the contrary, give a very even yield for a number of years, due largely to regularity in calving. It should be noted further that only one cow has had seven continuous yearly records; after a few years something is likely to happen rendering an animal unsuited for further service. A number of heifers of our own raising have been in milk from three to six years and bid fair to be of use for some time to come.

TABLE VI.

Summary of Yield.

	Yearly Records	Milk Pounds	Solids Percent	Solids Pounds	Fat Percent	Fat Pounds	Butter (Fat + 1-6) Pounds
Total,	131	790756.5	14.11	111613.8	5.07	40054.9	46694.7
Average per cow,		6036.3	14.11	852.0	5.07	305.8	356.4

The records of these 131 cows show that the average yearly yield was substantially 6000 pounds of 5 percent milk, equivalent to 356 pounds of butter. This is a very satisfactory record for either a grade or pure-bred Jersey herd. It must be remembered that the animals were selected, well cared for and intelligently fed. Comparatively few herds kept under conditions usually prevailing would have reached so high a production.

TABLE VII.

Cost of Production.

Average Yearly Food Cost per Cow	Net Yearly Fixed Charges per Cow (Estimated)	Total Cost per Cow	Average Yearly Yield per Cow		Cost of Milk	
			Pounds	Quarts	100 pounds	1 Quart (Cents)
$90.04	**$56.00**	**$146.04**	**6036.3**	**2683**	**$2.42**	**5.45**

In making the above calculations a quart of milk has been held to weigh 2.25 pounds. The theoretical weight is 2.15 pounds but the shrinkage in handling is sufficient to warrant the use of 2.25 as a practical conversion figure from pounds to quarts. The food cost of a quart is found to be 3.35 cents and the cost for care and supplies (net fixed charges), 2.10 cents. The figures indicate that the farmer having a superior herd of Jersey grades whose average milk yield is 6000 lbs. per cow, should receive substantially 5.5 cents per quart for it at the farm in order to get a fair market price for his roughage, and $35.00 per year for his labor, per cow, or $420.00 for 12 cows. If he had ordinary pasture for his herd this cost might be slightly reduced.* Profit other than the sale of roughage is not included, neither is allowance made for cost of supervision. Even if his herd consisted of grade Holsteins or Ayrshires it is doubtful if he would find it profitable to sell his milk for less, unless the average yearly yield was considerable in excess of the above.

*The dry weather of the last few summers has greatly reduced the value of the pasture.

DATA FROM OTHER SOURCES.

1. The Connecticut (Storrs) Experiment Station in Bulletin 73 gives complete data for five years, 1907-1911, of which the following is a summary:

Year	Number of Cows	Average Food Cost per Cow	Fixed Charges per Cow*	Total Cost per Cow	Average Production per Cow		Cost of Milk	
					Pounds	Quarts	100 Pounds	Quart (Cents)
1907	22	$72.85	$50.00	$122.85	4935.7	2193.6	$2.49	5.60
1908	19	77.08	50.00	127.08	6342.4	2818.8	2.00	4.51
1909	27	87 55	50.00	137.55	6946.5	3087.3	1.98	4.46
1910	29	87.49	50.00	137.49	7082.2	3147.6	1 94	4.37
1911	27	95.37	50.00	145.37	6586.9	2927.5	2.21	4.97
Average 124**		$84.07	$50.00	$134.07	6378.7	2835.0	$2 12	4.78

The herd was composed of Jerseys, Guernseys, Holsteins and Ayrshires. Accurate accounts were kept not only of the cost of feed but also of labor and other items of expense. The average for five years for 124 cows showed that the average cow produced 6379 pounds (2835 quarts) of 4.34 percent milk at a cost of 4.78 cents per quart at the barn.

2. The New Jersey Station† gives a careful account of the cost of the milk produced by its herd of 31 selected grade Holstein, Jersey, Ayrshire and Guernsey cows for the year 1909, of which the following is an abstract:

Number of Cows	Av'rage Weight per Cow	Average Food Cost per Cow	Fixed Charges per Cow	Total Cost per Cow	Average Production per Cow		Cost of Milk	
					Pounds	Quarts	100 Pounds	Quart (Cents)
31	1231	$ 95.73[1]	$70.22[2]	$165.95	8661	3850	$1.91	4.31
31	1231	121.60[3]	70.22	191.82	8661	3850	2.21	4.98

*Less $15.00 for value of manure and calf.
**Total number of cows.

†Thirty-first report, pp. 64-67.

[1] Figuring roughage at actual cost of production and grain at market prices.
[2] Value of manure and calf not deducted.
[3] Figuring roughage at market rates.

In the first case hay was figured at $4.82, green forage at $2.68, corn stover at 4.00 and silage at $3.50 per ton, said to be the actual cost of production. In the second case hay was figured at $15.00, green forage at $3.00, corn stover at $8.00 and silage at $5.00 per ton. The cows were unusually heavy and Holsteins largely predominated. They gave the remarkable average of 8661 pounds of milk per cow, testing 3.96 percent of fat at a cost of 4.31 and 4.98 cents per quart respectively. In case of such a herd if the farmer sold his roughage to his cows at cost, the cost of producing his milk at the farm would be 4.31 cents and if he secured market prices for his roughage the cost at the farm would be 5 cents per quart. The investigator states that "no charge is made for the investment in the farm itself or the dairy buildings and includes neither dairy apparatus, milk utensils, incidental expense, nor insurance."

3. The late Director Voorhees of the New Jersey Station presented figures on a somewhat different basis which are worthy of preservation.[1]

"The following statement represents the practice of the intelligent and progressive producer who realizes the importance of cleanliness and health of animals."

STATEMENT.

Investment.

Farm, 100 acres,	$7,500.00
Dairy barn,	1,000.00
Dairy house,	1,000.00
Dairy apparatus,	500.00
Dairy tools and implements,	1,500.00
Horses, (3 teams),	1,500.00
Cows, (40 @ $75.00),	3,000.00
One bull,	100.00
	$16,100.00

[1] From an address delivered before the New Jersey Sanitary Association, an abstract of which appeared in Hoard's Dairyman, January 10, 1908.

Annual Running Expenses.

Labor, (3 men @ $500.00), in barns, . .	$1,500.00
Labor, (1 man and boy), in dairy, . .	750.00
Labor, (2 men with teams), ...	1,000.00
Depreciation in value of cows, 10%, . .	310.00
Depreciation in value of horses, 10%, . .	150.00
Depreciation in value of tools, implements, etc.,	200.00
Taxes, insurance, and depreciation in buildings,	150.00
One-half cost of feed, ...	1,720.00
	$5,780.00
Interest on capital @ 5 percent, . . .	805.00
Total annual expense, including interest,	$6,585.00

In making the estimate for cost of feed no charge is included for all that is produced upon the farm, this being cared for in expense of labor and teams.

Allowing 7500 pounds of milk as the average product per cow, he figures that 100 pounds cost $2.20 and a quart 4.83 cents. He further figures that the owner regards himself as a full hand and makes no charge for supervision.

REMARKS ON THE RESULTS.

It is very evident from our own figures and from those derived from other sources that under present conditions it is not a satisfactory business to attempt to produce reasonably clean milk under the most ordinary conditions for less than 5 to 5 1-2 cents per quart at the farm. In fact, it is doubtful if practical business men would consider it as a business undertaking unless they were able to secure a price per quart for their milk at least 10 to 20 percent in advance over the cost of production.

The cost of production naturally would be considerably increased if the producer invests capital in a modern barn and well equipped dairy house, if his farm is located where taxes or labor is high, if he purchases nearly all of his feed, if he employs a superintendent or charges a reasonable sum for supervision, or if he makes an inspected or certified product.

Why has the producer received so low a price? It is the belief of the writer that in the past a great deal of milk has been made and sold

for less than the cost of production. In making an attempt to gain a temporary livelihood from dairying, many have sacrificed the fertility of their farms, employed the most primitive methods of housing and caring for the dairy stock, while the family have cared for the milk and for the dairy utensils without credit. The dairyman has forgotten or neglected to estimate his time at a fair value and to take into consideration the cost and depreciation of barn tools, dairy utensils, and such perishable tools and supplies as brushes, salt, soap, ice, bedding, bull service, veterinary services, and the like, all of which are absolutely necessary. In other words, the keeping of accurate accounts and the application of the ordinary business methods have been too often neglected. Such methods on the part of the producer as against the organized business method of the contractor have resulted in a measure at least in the establishing of a relatively low wholesale or retail price.

Now that health authorities are with right demanding better dairy methods, the producer is indeed confronted with a serious problem, namely, how to conform to modern sanitary requirements in the face of the increased cost of labor, grain and tools and produce milk at a reasonable profit. He is meeting this problem at present in a negative way, by selling his cows and trying to turn his attention to other lines of agricultural industry.

FIVE SUGGESTIONS FOR DAIRYMEN.

1. *Dairying should be combined with production of cash crops.* Experience indicates that as a rule it has not been profitable to produce milk as the only source of income, and sell it at wholesale in the general markets, at prices ordinarily prevailing. In fact, the statement has been made recently that in systems of intensive agriculture, the manure from the dairy herd is the real source of profit,—milk and butter being only by-products. Under conditions prevailing in Massachusetts it is possible to farm without dairy animals by placing dependence upon commercial fertilizers to keep up fertility. It is believed, however, that in the long run it will be better for the average farmer to combine both dairying and cash crop production, keeping one mature animal (horse or cow) to every four or five acres in crops (grass or cultivated areas). The farm manure is too valuable a factor to be neglected and every effort should be made to conserve and utilize it.

2. *A campaign of education* is needed to convince the public of the superior nutritive value of milk. It can be made clear that even at twelve cents a quart, *clean milk* is an economical article of diet.

Milk ought to be sold on a twofold basis: first, the variation in its food value should be recognized. It should be guaranteed to contain 12, 13 or 14 per cent total solids, or 3 1-2, 4 or 5 percent fat, and the price asked should be based on such a guarantee. If the wholesaler or distributor would begin to recognize these differences, the public, it is believed, would readily catch the meaning of the terms and govern itself accordingly.

Second, milk should be sold on a sanitary guarantee. Producers and peddlers should receive certificates from the proper authorities certifying that the milk offered was produced in a satisfactory manner. Such certificates may be graded by some such words as *prime*, *extra prime* and *choice*, or *commended*, *highly commended* and *certified*. The public would then have some ground on which to base its opinion as regards quality, and would be more willing to pay a price commensurate with the true value of the product.

3. *A reasonable system of inspection needed.* The writer is convinced that a reasonable system of state-wide milk inspection is needed. The public needs to be convinced that the milk supply of the state is properly safeguarded. If such a system were inaugurated, would not Massachusetts milk command a premium? The proper commission or bureau to manage and execute such a system should include men of both scientific training and practical experience. One without the other is useless. Education of the producer and a higher price for his product are needed more than law. The latter should be applied only as a last resort to persistent violators.

A properly organized bureau of milk inspection ought to co-operate with both producer and consumer and result not only in the production of a higher grade of milk but in helping to secure a better price for the product. War between producer and consumer or even lack of interest will never improve the dairy industry of the state. *Co-operation*, and not controversy or apathy, should be the watchword.

4. *A proper system of fodder crops* will, of course, help to keep down the cost of production. The most economical sources of roughage are corn, including silage, hay, clover, and alfalfa. The Illinois station has called attention to the advantages of a rotation of

corn and alfalfa. On farms where alfalfa can be successfully grown some such a rotation as corn, potatoes or other hoed crop and alfalfa ought to be productive of excellent results. Clover may be substituted in the rotation if alfalfa does not succeed. On light lands sensitive to droughts, alfalfa and corn should be more successful than corn and ordinary hay.

5. *Better cows mean a lessened cost of production.* Increasing the productivity of the herd is a slow process but it can be done if the farmer is studious and persistent. Breeding pure bred bulls to the best grade cows is probably the most economical method to follow. Better care and more feed are needed by a herd averaging 7500 pounds of 4 percent milk per year than one averaging 5000. Nevertheless, the higher the yearly production the less will be the cost per quart of milk.

TABLE VIII.

Dry and Digestible Matter Required for Maintenance and Milk Production.

(The tabulation which follows was made up for the most part by using average figures for dry matter and average digestion coefficients. These were applied to the amounts of foods actually consumed. The figures include both the dry and digestible matter required for maintenance and milk.)

Name.	Year.	Weight of Cow. lbs.	Milk Yield. lbs.	Dry Matter. 100 lbs. Milk.	Dry Matter. 1 lb. Solids.	Dry Matter. 1 lb. Fat.	Digestible Matter. 100 lbs. Milk.	Digestible Matter. 1 lb. Solids.	Digestible Matter. 1 lb. Fat.
Red........	1896	1050	6500.2	101.2	7.90	24.0	65.4	5.11	15.53
Bessie......	1896	825	7015.8	95.3	7.17	20.9	64.9	4.88	14.20
	1897	850	8322.2	98.2	7.30	21.6	64.8	4.82	14.20
	1898	925	7311.0	94.5	6.82	19.7	63.3	4.56	13.20
	1899	875	6975.3	82.1	5.83	16.9	54.6	3.87	11.20
	1900	950	10738.0	81.5	5.97	17.3	53.0	3.89	11.30
Beauty	1896	950	6218.7	115.2	7.93	22.4	74.7	5.14	14.53
	1897	1000	5749.8	119.0	8.58	23.1	74.2	5.35	14.40
	1898	1050	6578.9	118.1	7.87	22.2	78.8	5.25	14.80
	1899	1050	6813.4	112.5	7.43	21.2	71.0	4.69	13.40
Spot	1896	975	5802.9	115.6	8.07	23.3	75.2	5.25	15.19
Jennie......	1897	875	6071.8	104.7	6.80	18.3	67.4	4.36	11.80
	1898	925	6228.4	100.9	6.52	17.9	66.4	4.29	11.80
	1899	925	7128.2	95.5	6.09	16.8	62.8	4.00	11.10
	1900	975	5929.6	99.0	6.38	17.5	62.5	4.01	11.00
Mary	1897	825	5940.3	109.7	7.76	22.7	72.1	5.10	14.90
	1898	825	7401.6	94.8	6.76	19.7	62.9	4.49	13.10
	1899	850	6729.1	90.0	6.39	18.4	61.3	4.35	12.60
Black	1897	850	5095.1	106.2	7.50	21.6	69.8	4.93	14.20
Guernsey ..	1897	875	5627.3	106.3	7.56	21.2	70.6	5.02	14.00
	1898	900	5203.7	134.4	8.89	23.7	88.5	5.86	15.60
	1899	950	7996.3	89.3	5.91	15.7	59.7	3.96	10.50
Midget	1897	775	7022.8	100.0	7.34	22.9	66.9	4.91	15.30
	1898	825	5736.7	101.6	7.18	22.0	68.0	4.80	14.80
	1899	800	7398.9	81.2	5.64	17.6	53.7	3.73	11.60
Mildred	1897	850	7068.6	93.3	7.38	24.4	60.3	4.77	15.80
	1898	875	6441.6	99.1	7.77	24.5	65.8	5.16	16.30
	1899	900	4643.9	106.8	8.33	26.3	70.3	5.49	17.30
	1900	900	8119.2	78.0	6.11	19.6	50.3	3.94	12.70
Nina	1898	900	5766.7	108.9	8.24	26.2	73.2	5.53	17.60
	1899	900	7390.6	93.6	6.99	22.2	62.8	4.69	14.90
	1900	900	6003.3	92.2	6.89	22.2	59.9	4.47	14.40
Alice..... ..	1897	900	6537.8	114.3	8.20	24.7	75.9	5.45	16.40
Blossom....	1898	950	6266.9	105.2	7.20	21.0	70.1	4.80	14.00
	1899	975	6734.9	111.1	7.60	22.1	74.4	5.10	14.80
Sadie	1898	900	4980.2	109.5	7.75	21.8	73.7	5.22	14.70
	1899	875	6772.8	102.1	7.22	20.3	68.7	4.86	13.60
	1900	900	5825.0	94.1	6.65	18.7	67.0	4.29	12.00
Susie	1898	825	6634.5	121.6	7.70	20.2	81.7	5.18	13.60
Pearl	1900	1050	6519.2	105.6	7.28	18.6	66.9	4.61	11.80
	1901	1100	7918.2	128.2	8.84	22.6	82.8	5.71	14.60

TABLE VIII (Continued).

Name.	Year.	Weight of Cow. lbs.	Milk Yield. lbs.	Dry Matter.			Digestible Matter.		
				100 lbs. Milk.	1 lb. Solids.	1 lb. Fat.	100 lbs. Milk.	1 lb. Solids.	1 lb. Fat.
Dora	1901	875	6528.3	105.1	7.65	22.3	67.3	4.89	14.30
	1902	900	6194.8	102.4	7.45	21.7	65.2	4.75	13.80
	1903	888	6529.5	95.6	6.95	19.8	61.2	4.45	12.70
	1904	900	6165.7	105.6	7.66	19.5	69.2	5.02	12.80
	1905	885	6207.1	102.1	7.63	23.3	66.1	4.95	15.10
Ruth	1901	900	5074.7	130.5	—	32.3	84.2	—	20.80
Brighty	1902	863	5557.6	112.4	7.29	18.8	71.9	4.66	12.00
	1903	838	5828.9	103.8	6.90	17.7	65.6	4.36	11.20
	1904	838	5718.8	120.7	7.92	20.3	79.3	5.26	14.50
Linnie......	1902	825	6196.9	102.5	7.25	19.6	66.7	4.72	12.70
	1903	838	6790.6	94.9	6.72	18.2	61.0	4.32	11.70
May	1902	1000	6457.1	115.8	7.71	21.5	73.6	4.90	13.70
	1903	1025	6343.2	115.2	7.78	21.8	73.0	4.93	13.80
	1904	1000	5931.3	143.8	9.67	26.8	95.3	6.41	17.80
	1905	1055	4740.3	127.1	8.68	25.3	82.3	5.62	16.40
	1906	995	5056.5	121.9	8.18	23.3	68.4	4.59	13.10
Red II	1902	1025	4760.4	137.2	10.90	33.2	89.0	7.08	21.50
	1903	1000	9053.4	72.0	5.59	17.3	48.4	3.75	11.60
	1904	1025	8517.1	91.0	7.38	22.4	61.2	4.96	15.00
	1905	1047	7919.2	97.4	7.83	24.7	63.3	5.08	16.10
	1906	1001	7826.6	98.0	7.70	23.6	72.7	5.71	17.50
Rhoda	1902	837	5844.5	115.3	8.36	24.3	75.9	5.50	15.90
	1903	863	4977.2	102.5	7.51	21.9	66.2	4.85	14.10
Doliska	1903	775	6837.1	91.8	7.32	24.4	59.5	4.75	15.80
Daisy	1903	850	5636.0	117.3	7.64	20.3	76.2	4.97	13.20
	1904	838	5986.3	119.5	7.92	21.8	79.3	5.26	14.50
	1905	829	4956.4	134.6	8.82	24.6	84.7	5.56	15.50
	1906	863	4412.8	139.9	9.02	24.2	88.3	5.74	15.20
	1907	884	5333.0	122.5	7.93	21.1	76.3	4.93	13.10
	1908	853	3940.1	153.4	10.20	26.7	94.1	6.24	16.30
	1909	835	4665.5	127.5	8.70	22.4	79.1	5.40	13.90
Blanche	1901	1100	7528.3	130.2	9.16	26.5	82.8	5.83	16.80
	1902	1175	5700.1	124.5	8.76	25.4	78.7	5.54	16.00
	1903	1175	6999.1	105.1	7.31	20.9	67.3	4.68	13.40
	1904	1163	7101.5	110.1	7.75	21.3	71.4	5.03	13.80
	1905	1115	5260.3	137.1	9.64	28.7	88.0	6.19	18.50
	1906	1189	4451.8	140.1	9.67	28.3	89.3	6.17	18.00
Fancy	1905	862	5961.5	109.8	8.03	24.5	70.3	5.14	15.70
	1906	885	5193.9	126.2	9.19	27.1	80.5	5.86	17.30
	1907	918	6640.8	90.6	6.53	19.0	56.6	4.10	11.90
Molly	1905	1025	4622.3	136.2	9.12	27.1	87.6	5.86	17.40
Gladys	1905	687	4215.6	130.9	8.98	24.6	86.7	5.95	16.30
	1906	761	5387.7	135.2	9.26	25.2	101.5	6.95	18.80
	1907	795	6142.2	101.4	6.99	19.0	62.1	4.21	11.80
	1908	788	5279.6	151.2	10.49	27.9	95.7	6.63	17.60
	1909	783	6028.6	112.7	8.00	21.1	73.1	5.17	13.70
	1910	791	6500.3	126.7	8.70	22.7	81.5	5.60	14.60
	1911	845	4498.6	172.0	12.10	30.7	108.5	7.60	19.40
May Rio ..	1905	712	4656.9	121.0	8.33	23.0	79.7	5.48	15.20
	1906	765	5160.4	115.8	7.82	20.4	74.4	5.02	13.10

TABLE VIII (Continued).

Name.	Year.	Weight of Cow. lbs.	Milk Yield. lbs.	Dry Matter.			Digestible Matter.		
				100 lbs. Milk.	1 lb. Solids.	1 lb. Fat.	100 lbs. Milk.	1 lb. Solids.	1 lb. Fat.
	1907	883	5027.1	122.8	8.21	21.2	75.2	5.02	12.60
	1908	849	5561.8	130.0	8.79	21.7	78.4	5.30	13.10
	1909	827	5515.5	131.6	9.03	22.3	84.5	5.80	14.30
	1910	930	6524.9	132.5	8.90	22.2	84.2	5.70	14.20
Samantha ..	1906	957	6042.6	121.9	8.17	22.4	79.1	5.30	14.50
	1907	998	6456.8	119.8	7.40	20.1	75.7	4.67	12.10
	1908	1025	6197.5	157.4	10.40	27.1	108.6	7.16	18.70
	1909	1029	6311.5	118.8	8.00	19.8	73.6	5.00	12.30
	1910	1052	6801.8	120.6	8.00	20.4	73.9	4.90	12.50
	1911	1078	6550.6	146.5	9.60	23.5	92.0	6.00	14.80
Betty	1906	712	4784.5	146.3	10.10	29.0	93.3	6.44	18.50
	1907	787	5790.2	120.9	8.54	24.4	77.7	5.43	15.60
	1908	830	6123.3	133.6	9.20	25.7	86.0	5.95	16.50
	1909	831	5530.2	131.8	9.20	25.2	83.4	5.80	15.90
	1910	825	6004.2	118.4	9.00	25.2	82.7	5.70	16.00
	1911	918	5969.3	148.6	10.40	28.9	94.3	6.60	18.30
Maude	1906	812	4002.6	160.3	10.60	29.2	144.2	6.93	19.00
Cecile	1907	711	5730.7	124.6	8.80	25.7	77.9	5.49	16.10
	1908	750	6176.5	124.1	8.70	24.3	80.5	5.67	15.80
	1909	782	5304.0	145.9	10.20	23.6	94.1	6.60	17.70
	1910	792	6854.6	121.6	8.40	23.2	77.6	5.40	14.80
	1911	840	6158.4	124.8	8.80	24.9	78.3	5.50	15.60
Chub	1908	958	4707.3	168.2	13.60	43.9	113.8	9.18	29.70
Minnie	1908	936	5010.5	131.1	11.15	35.0	80.0	6.81	21.40
	1909	964	5457.2	113.8	8.70	27.0	69.8	5.30	16.60
Mary	1908	1048	6688.5	103.5	7.70	23.5	68.7	4.97	15.20
Red III	1908	756	5010.6	148.1	11.20	28.7	94.8	7.14	18.30
	1909	811	6207.1	115.2	8.60	22.3	72.8	5.45	17.20
	1910	843	6490.8	120.9	8.80	23.3	73.7	5.40	14.20
	1911	904	6900.5	115.8	8.50	21.8	72.4	5.30	13.60
Betty II....	1909	720	5158.3	143.1	10.60	36.8	92.3	6.80	17.40
	1910	607	7404.8	114.6	8.50	24.4	73.3	5.40	15.60
	1911	860	6715.5	109.1	7.80	22.0	68.3	4.90	13.80
Amy.......	1910	633	4472.8	132.0	8.90	23.1	82.4	5.50	14.40
	1911	713	4177.3	175.2	11.90	30.5	110.8	7.50	19.30
Fancy II ..	1910	675	4403.8	131.3	9.60	27.1	81.7	6.00	16.80
	1911	702	4897.4	121.3	8.80	24.0	76.2	5.50	15.10
Ida	1910	737	3940.6	161.9	10.10	24.4	100.3	6.20	15.10
	1911	829	4155.0	195.1	12.20	28.9	121.5	7.60	18.00
Fancy III...	1911	788	5164.1	132.4	10.10	28.5	84.7	6.50	18.30

TABLE IX

Average Results (Pounds)

Average Weight of Cow.	Milk Yield.	Dry matter required to produce:			Digestible matter required to produce:		
		100 lbs. Milk.	1 lb. Solids.	1 lb. Fat.	100 lbs. Milk.	1 lb. Solids.	1 lb. Fat.
891	6036.3	117.9	8.28	23.3	76.4	5.34	11.49

Table VIII shows extremes of from 72 to 195 pounds of dry matter fed for maintenance and to produce 100 pounds of milk, while the average as given in Table IX is 117.9 pounds.

In case of the digestible matter the extremes are 53 and 144 pounds and the average is 76.4 pounds. The extremes and the average do not mean that such amounts of dry and digestible matter were absolutely necessary, because the animal might have done equally as good work with somewhat less food than was actually fed. A continuation, however, of liberal feeding after the first few months of lactation is favorable to keeping up the yield during the entire period.

TABLE X

This table shows the relation of dry and digestible matter as well as the relation of weight of animal to production.

Average Yield. (Pounds).	Number of Cows.	Percentage of Whole.	Average Weight. (Pounds).	Dry matter required to produce:		Digestible matter required to produce:	
				100 lbs. Milk.	1 lb. Solids.	100 lbs. Milk.	1 lb. Solids.
Cows averaging between 7,000 and 8,000 pounds yearly.							
7809.2	20	15.2	926	96.84	7.11	64.07	4.75
Cows yielding between 6,000 and 7,000 pounds yearly.							
6462.9	46	35.1	914.1	111.2	7.79	71.8	5.02

Average Yield (Pounds).	Number of Cows.	Percentage of Whole.	Average Weight. (Pounds).	Dry matter required to produce: 100 lbs. Milk.	Dry matter required to produce: 1 lb. Solids.	Digestible matter required to produce: 100 lbs. Milk.	Digestible matter required to produce: 1 lb. Solids.
Cows yielding between 5,000 and 6,000 pounds yearly.							
5553.7	37	28.2	884.0	121.7	8.24	78.3	5.29
Cows yielding between 4,000 and 5,000 pounds yearly.							
4634.6	14	10.7	893.3	139.7	9.73	89.45	6.23
Heifers with first calves.							
4717.9	12	—	767.8	138.9	9.80	92.35	6.28

The data as above given show that the cows yielding the largest amount of milk produced it with the least amount of dry and digestible matter. Thus the 20 cows, averaging 7809 pounds of milk yearly, required 7.11 pounds of dry matter and 4.75 pounds of digestible matter to produce one pound of milk solids; the cows yielding between 5000 and 6000 pounds required 8.24 pounds of dry matter and 5.29 pounds of digestible matter; those yielding between 4000 and 5000 pounds required 9.73 pounds of dry matter and 6.23 pounds of digestible matter. Twelve heifers with first calves averaged 4718 pounds of milk and required 9.80 pounds of dry matter and 6.28 pounds of digestible matter for each pound of milk solids produced. In other words, the large producers required less food to produce a definite amount of milk than the small producers.

It is also worthy of note that of the 131 cows under trial, 15 percent produced nearly 8000 pounds yearly; 35 percent approximately 6500 pounds yearly; 28 percent yielded 5554 pounds yearly, and 11 percent averaged 4635 pounds per year. Sixty-three percent of the cows produced between 5500 and 6500 pounds per year. The cows yielding below 5000 pounds yearly one could not afford to keep continuously; those yielding between 5500 and 6500 represent a general average, and under most conditions should prove

reasonably profitable: the larger the number in the herd yielding above 7000 pounds each year, the more profitable would be the herd.*

The herd was not composed of large cows, the average cow weighing substantially 900 pounds. So far as it is possible, however, to draw conclusions concerning the relation of size to production, note that the cows producing an average yield of 7809 pounds averaged 926 pounds in weight, and those producing an average of 4635 pounds of milk averaged 893 pounds.

The above figures bear out the observations of Woll and others that the largest cows are as a rule the most economical producers.

Concluding Thoughts.

The writer has hesitated in putting out this bulletin for several reasons and particularly because so many of the items entering into the cost of a quart of milk necessarily have been estimated.

The records of the amount of the various foods consumed were all carefully kept, and the cost of the grain was based upon market prices. The figures used, however, for the cost of silage and green food consumed were based upon estimates, while what may be termed market prices were used in computing the value of the hay and corn stover. The expenses other than food cost (fixed charges) are also estimated.

In order to get at the average cost of all items entering into the problem, a more satisfactory way, probably, would be for a person having a good understanding of practical agriculture *and particularly of farm accounting* to co-operate with a number of dairy farmers in a careful study of the problem. In some cases present methods of production may be studied and the cost tabulated, while in other cases, the producer might be induced to follow more modern methods and their results upon the cost of production noted. It is hoped that some such method of studying the problem can be undertaken.

The object of the present bulletin will have been attained, however, if it stirs the thought of the dairyman and encourages him to give more attention to the business side of the industry. He can apply his own available data to the numerous items mentioned in this

* The writer fully realizes the difficulty of securing and maintaining a herd of 7000-pound cows. Nevertheless, there are many such herds in the state and the dairyman should have such an ideal ever before him.

bulletin as entering into the cost of milk production, and note how his completed calculations compare with those here stated.

This bulletin is in no way intended to discourage Massachusetts dairymen. In view of the present unsatisfactory condition of the industry in Massachusetts, it is believed that all the light possible should be thrown upon the cause of the trouble, and efforts made to improve it. As long as a large number of producers are obliged to sell their product at cost or below cost, the industry cannot be pronounced prosperous. Dairying in many parts of this state must be followed if our agriculture is to be successful and the writer is enough of an optimist to believe that with the education of the public to the nutritive and economic value of dairy products and the following of the most approved methods, the future success of the industry will be realized.

SUPPLEMENT.

Detailed Statement of Fixed Charges.

Professor Trueman* presents the following figures, based on actual results secured at the Storrs Station, as the cost of keeping a cow for one year, exclusive of feed. He considers them representative for Connecticut for the five years, October 1, 1906—October 1, 1911:

Bedding, for one year,	$5.00
Keep of bull, per cow,	3.00
Labor per year, per cow,	33.60
Interest on money invested in cow and barn,	6.75
Taxes on cow and barn,	1.25
Insurance on barn,	.40
Depreciation of cow (yearly),	13.00
Light, heat, medicines, disinfectants, veterinary, and ice,	2.00
	$65.00

Trueman* allows $10 for the value of the manure and $5 for each calf. Deducting the $15 we have $50 net for fixed charges.

Professor Minkler of the New Jersey Station † states that the following charges represent the cost of keeping a cow for a year (not including feed), based on the actual cost of labor. He does not include supervision :

Labor (one man for 12 cows) at $1.50 per day,	$43.00
Bedding (one bale shavings for 20 cows per day),	5.29
Stabling, ...	5.00
Interest, 5 per cent on $100 (value of one cow),	5.00
Depreciation in value of cow, 10 per cent per cow,	10.00
Bull ($200 at 5 per cent, $10 ; cost of keep $50) per cow, ...	1.93
Average per cow per year, . . .	$70.22
Average per cow per day, . . .	.192

He states that in the above "no charge is made for the investment in the farm itself or the dairy buildings, and includes neither dairy apparatus, milk utensils, incidental expenses nor insurance." The value of the manure and calf is not deducted from the above.

* Bulletin 73, Storrs (Conn.) Experiment Station, p. 130.

† Thirty-first report of the New Jersey Station, 1909, p. 65.

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BULLETIN No. 146. OCTOBER, 1913.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION.

INSPECTION OF

COMMERCIAL FEED STUFFS

BY

P. H. SMITH and C. L. BEALS.

This bulletin contains the analyses of commercial feed stuffs found in the Massachusetts markets during the year (September, 1912 - September, 1913), together with such comments as are called for by the results of the inspection. In addition will be found a tabulated list of the wholesale cost of feed stuffs for the year.

Requests for bulletins should be addressed to the
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Annual reports and bulletins are sent free on request to all parties interested in agriculture. Correspondence or consultation on all matters affecting any branch of experiment station work is welcomed. Communications should be addressed to the

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

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INSPECTION OF COMMERCIAL FEED STUFFS

By P. H. Smith, *Chemist in Charge,*

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INTRODUCTION.

This bulletin contains the results of the first year's work under the revised feeding stuffs law which went into effect September 1, 1912. There have been collected and examined, since the publication of the previous bulletin, 1115 samples, all of which practically conformed to their guarantees. The year has been considered one of adaptation to new conditions and no prosecutions for violations of the law have been made, although where infringement of the statute was noted attention was called to the matter through correspondence and conditions corrected. So far as we were able to ascertain, there were no flagrant violations of the law.

The text of the new law was published in Bulletin No. 142. Its intent and purpose is to prevent fraud and to insure to the consumer information that will make possible the intelligent selection of commercial feeding stuffs. With this end in view the law requires manufacturers to label their goods in such a way as to make this information available. The guarantee attached to a feeding stuff should not be taken to mean that the feed has exceptional feeding value. Anything not absolutely injurious to animals may be incorporated in a feeding stuff so long as the guarantee tells the truth. The purchaser should take nothing for granted but should read the guarantee and judge for himself. When in doubt, he should apply to the experiment station for further information.

It is a commendable fact that, with few exceptions, manufacturers have been willing to comply fully with the requirements of the law. A notable exception is found in the case of millers who assume that they have the privilege of incorporating screenings with pure wheat by-products and selling the mixture as wheat bran, wheat middlings or wheat mixed feed. Wheat

by-products that contain screenings other than those that unavoidably pass through the rolls with the wheat, should be guaranteed as containing screenings.

The terms used in naming the ingredients of a prepared feeding stuff should be clear and concise and not lend themselves to a double or misleading interpretation. For example, the term "oil meal" for linseed meal or linseed oil meal; "bran" for wheat bran, "meal" for corn meal, is not definite enough and might mean any kind of oil meal, bran, or meal where only linseed meal, wheat bran and corn meal were intended. "Gluten" or "gluten meal" are terms also often used in place of gluten feed. Gluten meal and gluten feed are quite different in percentage of chemical composition and the names should not be used interchangeably.

Attention is also called to the fact that the net weight of the contents of the package must be stated on the guarantee tag. This does not include the weight of the sack.

The objection has occasionally been made that a state feeding stuffs law discriminates against the local dealer and does not reach the manufacturer who may not reside in Massachusetts. To the writer it does not seem incompatible with good business for the dealer to become familiar with the law and make his contracts for goods subject to Massachusetts inspection and to be tagged in accordance with Massachusetts laws.

In case of mixed or prepared feeds containing two or more substances the "certified ingredients" are also stated. A microscopic examination has shown them to contain substantially the ingredients certified. The following tables should prove of value to the consumer in deciding the most economical feeding stuffs for him to purchase.

In general, unmixed by-products such as cottonseed meal, linseed meal, gluten feed, distillers' grains, corn meal, hominy feed, beet pulp, and the like will prove more economical than many of the prepared mixtures which frequently contain material of inferior feeding value. There are some exceptions to this general statement and the purchaser need not be misled if he will read the guaranteed list of ingredients which is or should be attached to every package of prepared feeding stuff.

CHEMICAL ANALYSIS OF FEED STUFFS.

1911-1912 [*Fall and Winter.*]

I Protein Feeds

COTTONSEED MEAL.

Definition. *COTTONSEED MEAL is the ground residue obtained in the extraction of oil from the cottonseed kernel.
CHOICE cottonseed meal contains at least 41 per cent protein.
PRIME cottonseed meal contains from 38.5 to 41 per cent protein.
GOOD Cottonseed meal contains from 36 to 38.5 per cent protein.
COTTONSEED FEED is a mixture of cottonseed meal and cottonseed hulls containing less than 36 per cent protein.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Choice		%	%	%	%	%	%
American Cotton Oil Co., New York, N. Y.							
C. S. Barber	Bernardston	41.42	41.00	7.93	9.00	6.15	10.50
C. A. Pierce	Hinsdale	42.21	41.00	8.19	9.00	6.50	10.50
F. W. Brode & Co., Memphis, Tenn.							
Dove, Rollstone Grain Co.	Fitchburg	41.03	38.63	6.99	6.00	9.43	10.00
Owl, Haverhill Milling Co.	Haverhill	42.91	41.00	6.77	6.00	7.14	10.00
Owl, C. G. Burnham	Holyoke	41.59	41.00	6.93	6.00	9.38	10.00
Owl, N. Hatfield Grain Co.	N. Hatfield	41.68	41.00	7.05	6.00	9.04	10.00
Owl, N. Hatfield Grain Co.	N. Hatfield	45.53	41.00	8.25	6.00	4.76	10.00
Owl, Ropes Bros.	Salem	43.26	41.00	9.03	6.00	7.05	10.00
Owl, L. A. Snow	Upton	44.22	41.00	7.52	6.00	7.14	10.00
T. H. Bunch Commission Co., Little Rock, Ark.							
Old Gold, Milford Grain Co.	Milford	44.22	41.00	7.61	9.00	6.54	9.00
Old Gold, M. H. Rolfe Est.	Newburyport	42.08	41.00	6.73	9.00	9.97	9.00
Old Gold, F. A. Fales & Co.	Norwood	42.82	41.00	6.79	9.00	9.12	9.00
Old Gold, F. A. Fales & Co	Norwood	42.46	41.00	7.56	9.00	6.57	9.00
Chapin & Co., Hammond, Ind.							
Green Diamond, G. A. Fair	Holliston	42.03	41.00	8.03	8.00	7.19	10.00
S. P. Davis, Little Rock, Ark.							
Good Luck, Worcester Hay & Gr. Co.	N. Brookfield	42.99	41.00	9.16	7.00	4.89	10.50
Farmers Cot. Oil & Trading Co., Uniontown, Ala.							
I. J. Rowell	Pepperell	42.82	41.00	8.92	9.00	7.43	7.00
Humphreys Godwin Co., Memphis, Tenn.							
Dixie, C. P. McClanathan	Barre Plains	41.42	38.62	7.35	6.00	7.65	12.00
Dixie, W. E. Bryant & Co.	Brockton	45.76	38.62	7.79	6.00	6.95	12.00
Dixie, C. W. Upham	Foxboro	41.24	38.62	8.25	6.00	10.15	12.00
Forfat, H. G. Hill Co.	Williamsburg	41.16	38.62	8.35	6.00	7.93	12.00
Imperial Cotto Milling Co., Memphis, Tenn.							
Imperial, Rollstone Grain Co.	Fitchburg	41.07	41.00	7.60	8.00	9.02	9.00
Memphis Cot. Seed Products Co., Memphis, Tenn							
Selden, Prentiss Brooks & Co.	Easthampton	42.47	41.00	8.49	6.00	6.22	10.00
Selden, Prentiss Brooks & Co.	Westfield	43.43	41.00	6.76	6.00	9.70	10.00
W. Newton Smith, Baltimore, Md.							
Dirigo, W. Lord	Athol	46.05	41.00	7.40	7.00	6.17	10.50
Dirigo, C. P. McClanathan	Barre Plains	42.12	41.00	6.76	7.00	8.40	10.50
Dirigo, I. J. Rowell	Pepperell	41.42	41.00	6.23	7.00	8.55	10.50
Dirigo, Warren Grain Co.	Warren	42.91	41.00	7.04	7.10	7.10	10.50

*Definitions used in connection with these tables merely indicate our basis of classification. So far as possible they are based on trade usage, and are subject to future change and revision.

COTTONSEED MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
J. E. Soper Co., Boston, Mass.							
Pioneer, MacKenzie & Winslow, Inc	Fall River	41.51	41.00	6.81	7.00	8.53	10.00
Pioneer, MacKenzie & Winslow, Inc	Fall River	41.68	41.00	6.86	7.00	8.08	10.00
Pioneer, M. G. Williams	Raynham	42.64	41.00	7.19	7.00	7.07	10.00
Southern Cotton Oil Co., Charlotte, N. C.							
Bonita, A. T. Knight & Co.	Hudson	41.24	38.62	7.98	6.00	8.82	10.00
Average		42.56	—	7.56	—	7.69	—
Prime							
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
A. T. Butler	Adams	39.41	38.50	8.04	6.50	8.30	12.00
A. E. Lawrence & Son	Ayer	40.15	38.50	7.54	6.50	7.98	10.00
Evans-Bowker	Baldwinsville	39.23	38.50	8.00	6.50	9.50	10.00
C. S. Tarbox	E. Braintree	38.57	38.50	7.80	6.50	7.60	12.00
Bryant & Soule	Middleboro	38.61	38.50	6.77	6.50	11.40	12.00
Thorne Bros.	Millis	38.96	38.50	8.33	6.50	10.15	12.00
H. C. Puffer Co.	Springfield	40.98	38.50	7.20	6.50	9.63	12.00
T. H. Bunch Com. Co., Little Rock, Ark.							
Acme, F. Gauvin	Marlboro	39.67	38.60	7.52	7.00	10.17	8.00
Acme, Bryant & Soule	Middleboro	38.88	38.60	8.40	7.00	9.37	12.00
Acme, J. Cushing & Co.	Stoughton	38.53	38.60	8.37	7.00	8.79	8.00
Old Gold, Hingham Grain Mill, Inc.	Hingham	39.42	41.00	7.93	9.00	7.10	9.00
S. P. Davis, Little Rock, Ark.							
Good Luck, S. L. Davenport & Son	N. Grafton	39.49	41.00	7.79	7.00	10.46	10.50
Florida Cotton Oil Co., Jacksonville, Fla.							
Peerless, Hingham Grain Mill, Inc.	Hingham	39.93	41.00	8.71	7.50	10.22	8.00
Glen Mills Cereal Co.	Rowley	38.48	38.62	8.65	7.00	10.20	—
Humphreys Godwin Co., Memphis, Tenn.							
Dixie, Scott Grain Co.	Amesbury	40.81	38.62	6.73	6.00	9.18	12.00
Dixie, W. Lord	Athol	39.84	38.62	6.76	6.00	9.60	12.00
Dixie, C. S. Barber	Bernardston	40.63	38.62	6.00	6.00	10.73	12.00
Dixie, Eastern Grain Co.	Bridgewater	38.87	38.62	6.47	6.00	9.90	12.00
Dixie, N. Attleboro Grain Co.	N. Attleboro	39.49	38.62	7.93	6.00	10.43	12.00
Dixie, W. P. Barney	Seekonk	39.23	38.62	7.93	6.00	11.06	12.00
Dixie, J. B. Bridges & Co.	S. Deerfield	39.63	38.62	7.92	6.00	8.36	12.00
Dixie, H. G. Hill Co.	Williamsburg	39.93	38.62	11.07	6.00	9.63	12.00
Forfat, W. L. Palmer	Medway	39.23	38.62	9.59	6.00	9.22	12.00
Forfat, Goding Bros.	N. Easton	39.49	38.62	8.96	6.00	8.03	12.00
Forfat, Cutler Grain & Coal Co.	Palmer	38.70	38.62	6.65	6.00	10.86	12.00
Imperial Cotto Milling Co., Memphis, Tenn.							
E. J. Adams	Gt. Barrington	38.53	38.62	6.54	7.00	10.95	12.00
Keeton, McArthur Co., Atlanta, Ga.							
Peacock, Ropes Bros.	Danvers	39.58	41.00	7.17	6.00	10.95	10.00
Kemper Mill & Elev. Co., Kansas City, Mo.							
Anchor, Cutler Co.	N. Brookfield	40.63	41.00	6.98	7.50	8.85	10.00
Memphis Cot. Seed Products Co., Memphis, Tenn.							
Selden, Milford Grain Co.	Milford	39.67	41.00	6.85	6.00	9.38	10.00
W. C. Nothern, Little Rock, Ark.							
Bee, Marlboro Grain Co.	Marlboro	40.37	41.00	7.11	6.00	8.06	10.00
W. Newton Smith, Baltimore, Md.							
Dirigo, W. N. Potter & Co.	Charlemont	39.63	41.00	8.75	7.00	7.35	10.50
Dirigo, C. G. Jordan	Weymouth	39.14	41.00	7.92	7.00	11.57	10.50
Dirigo, C. L. Beals & Co.	Winchendon	40.89	41.00	7.28	7.00	8.90	10.50

COTTONSEED MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
J. E. Soper Co., Boston, Mass.							
Pilgrim,............C. B. Sampson..........	Holyoke........	40.37	38.60	8.53	5.00	7.42	10.00
Pilgrim,............H. K. Webster Co........	Lawrence.......	39.14	38.50	8.57	5.00	10.83	10.00
Pilgrim,............J. M. Buck..............	Stockbridge.....	39.49	38.50	7.27	5.00	9.66	10.00
Pioneer,............Knight Grain Co.........	Newburyport....	40.54	41.00	6.12	7.00	8.78	10.00
Southern Cotton Oil Co., Charlotte, N. C.							
Bonita,............Bond Grain Co..	Charlton........	39.14	38.62	7.42	6.00	10.41	10.00
Good							
Buckeye Cotton Oil Co., Cincinnati, Ohio.							
Prime,*............A. E Lawrence & Son....	Ayer...........	37.56	38.50	6.87	6.50	12.47	12.00
Prime,*............H. Bullukian............	Franklin........	37.78	38.50	7.03	6.50	8.70	12.00
Prime,*............Bosworth & Son.........	Leominster......	37.21	38.50	6.59	6.50	12.26	12.00
Prime,*............C. Parkinson............	Seekonk........	38.00	38.50	6.46	6.50	12.50	12.00
Prime,*............Taunton Grain Co........	Taunton........	35.81	38.50	7.25	6.50	12.08	12.00
T. H. Bunch Com. Co., Little Rock, Ark.							
Acme,.............C. H. Smith.............	Dighton........	37.13	38.60	7.12	7.00	10.22	12.00
Acme,.............W. J. Meek.............	Fall River.......	38.18	38.60	8.01	7.00	10.31	12.00
Acme,.............N. Adams Flour & Gr. Co.	N. Adams......	38.44	38.60	6.55	7.00	10.90	8.00
Old Gold,..........A. E. Lawrence & Son....	Ayer...........	36.95	41.00	12.10	9.00	8.86	9.00
Humphreys Godwin Co., Memphis, Tenn.							
Dixie,.............A. F. Sanctuary.........	Amherst........	36.34	38.62	6.33	6.00	13.40	12.00
Dixie,.............I. Morton & Co..........	Plymouth.......	36.86	38.62	8.22	6.00	9.38	12.00
Dixie,.............P. W. Eaton & Co........	Williamstown...	38.09	38.62	7.66	6.00	9.38	12.00
Forfat,............A. C. Boice.............	Conway........	38.26	38.62	8.48	6.00	9.49	12.00
Forfat,...........Plummer & Jennings Gr. Co.	New Bedford....	36.60	38.62	6.86	6.00	11.42	12.00
Memphis Cot. Seed Products Co., Memphis, Tenn.							
Selden,............F. Diehl & Son..........	Wellesley.......	37.83	41.00	11.13	6.00	11.10	10.00
W. Newton Smith, Baltimore, Md.							
Dirigo,............N. Hatfield Grain Co.....	N. Hatfield......	36.43	41.00	8.57	7.00	10.76	10.50
Dirigo,............A. Milot & Son..........	Taunton........	37.39	41.00	9.17	7.00	9.66	10.50
J. E. Soper Co., Boston, Mass.							
Pilgrim,...........Hingham Grain Mill, Inc.	Hingham.......	38.30	38.50	8.27	5.00	10.50	10.00
Average (prime and good)		38.86	—	7.79	—	9.90	—
Cottonseed Feed.							
T. H. Bunch Com. Co., Little Rock, Ark.							
Golden Rod,......Plummer & Jennings Gr. Co.	New Bedford....	20.97	20.00	3.70	4.00	25.15	29.00
Humphreys Godwin Co., Memphis, Tenn.							
Creamo,...........H. C. Bowen & Son......	Cheshire........	20.66	20.00	4.22	5.00	21.33	22.00
Creamo,...........G. C. Turner............	Chester.........	23.64	20.00	5.32	5.00	19.38	22.00
Creamo,...........G. F. Wetherbee Co	Gardner........	22.94	20.00	3.93	5.00	20.15	22.00
Creamo,...........J. O. Ellison & Co........	Haverhill.......	23.56	20.00	5.93	5.00	16.75	22.00
Creamo,...........J. B. Bridges & Co........	S. Deerfield.....	22.68	20.00	4.13	5.00	21.77	22.00
Southern Fiber Co., Portsmouth, Va.							
Royal,............Bedford Coal & Grain Co.	Bedford........	16.64	22.00	3.23	4.00	27.47	22.00
Royal,............W. E. Bryant & Co.......	Brockton.......	21.10	22.00	4.07	4.00	25.87	22.00
Royal,............Mackenzie & Winslow, Inc.	Fall River......	22.23	22.00	4.35	4.00	24.82	22.00
Royal,............C. B. Sampson..........	Holyoke........	21.36	22.00	3.48	4.00	25.39	22.00
Royal,.............Marlboro Grain Co.......	Marlboro.......	23.03	22.00	4.00	4.00	23.97	22.00

*Misbranded Prime.

LINSEED MEAL.

Definition. Linseed meal is the ground residue obtained in the extraction of oil from flaxseed.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
1. New Process.							
American Linseed Co., New York, N. Y.							
Cleveland Flax Meal, Ropes Bros.	Salem	37.48	36.00	2.75	1.00	8.89	7.00
Cleveland Flax Meal, Morse Bros.	Southbridge	38.26	36.00	1.91	1.00	8.30	7.00
J. E. Merrick & Co.	Amherst	35.81	36.00	2.40	1.00	8.97	7.50
V. E. Moore	Springfield	37.30	36.00	2.19	1.00	8.22	7.50
Average		37.21	—	2.31	—	8.59	—
2. Old Process.							
American Linseed Co., New York, N. Y.							
M. C. Richmond	Adams	35.73	34.00	5.94	5.00	7.57	8.00
W. E. Bryant & Co.	Brockton	33.54	34.00	5.64	5.00	8.13	8.00
Mackenzie & Winslow, Inc.	Fall River	34.50	34.00	5.69	5.00	7.95	8.00
F. F. Woodward Co.	Fitchburg	37.21	34.00	6.94	5.00	7.71	8.00
S. L. Davenport & Son	N. Grafton	35.20	34.00	5.60	5.00	8.04	8.00
Morse Bros.	Southbridge	36.43	34.00	5.60	5.00	8.05	8.00
J. Cushing & Co.	Winchendon	34.94	34.00	7.80	5.00	7.39	8.00
American Milling Co., Chicago, Ill.							
Amco, H. K. Webster Co.	Lawrence	34.06	32.00	6.46	6.00	7.68	11.00
Amco, N. Adams Flour & Gr. Co.	N. Adams	34.94	32.00	7.02	6.00	7.86	11.00
Archer-Daniels Linseed Co., Minneapolis, Minn.							
Knight Grain Co.	Newburyport	36.54	32.00	6.55	6.00	7.60	10.00
W. P. Barney	Seekonk	37.83	32.00	7.27	6.00	6.71	10.00
Husted Milling Co., Buffalo, N. Y.							
Ropes Bros.	Salem	34.85	32.00	7.03	5.00	8.09	—
Kelloggs & Miller, Amsterdam, N. Y.							
W. N. Potter & Co.	Charlemont	35.90	33.00	7.86	5.00	6.82	7.50
W. N. Potter Grain Co.	Princeton	35.29	33.00	7.43	5.00	7.60	7.50
Guy G. Major Co., Toledo, Ohio.							
J. H. Nye	Brockton	31.18	30.00	6.49	5.00	8.47	10.00
W. J. Meek	Fall River	32.99	30.00	5.97	5.00	8.38	10.00
C. A. Pierce	Hinsdale	31.88	30.00	6.46	5.00	8.92	10.00
Mackenzie & Winslow, Inc.	New Bedford	32.31	30.00	6.36	5.00	7.21	10.00
Metzger Seed & Oil Co., Toledo, Ohio.							
Dresser Hull Co.	Lee	33.45	30.00	6.59	5.00	8.34	10.00
P. Foisy	New Bedford	33.96	30.00	7.03	5.00	8.15	10.00
Albert Culver Co.	Rockland	34.14	30.00	6.27	5.00	3.81	10.00
Ropes Bros.	Salem	33.34	30.00	6.95	5.00	7.80	10.00
S. R. Carter	W. Berlin	31.84	30.00	7.00	5.00	8.30	10.00
Midland Linseed Products Co., Minneapolis, Minn.							
Eastern Grain Co.	Bridgewater	32.84	32.00	7.03	6.00	8.36	8.50
Peterson Coal & Grain Co.	Gt. Barrington	36.51	32.00	6.45	6.00	7.17	8.50
Northern Linseed Co., Minneapolis, Minn.							
W. E. Bryant & Co.	Brockton	37.47	32.00	7.12	6.00	8.48	9.00
J. H. Nye	Brockton	36.86	32.00	6.32	5.00	7.98	9.00
Red Wing Linseed Oil Co., Red Wing, Minn.							
C. P. McClanathan	Barre Plains	36.51	32.00	7.88	6.00	6.50	10.00
Plummer & Jennings Gr. Co	New Bedford	35.45	32.00	7.53	6.00	10.15	10.00
N. Attleboro Grain Co.	N. Attleboro	30.58	32.00	7.93	6.00	7.63	10.00
Spencer-Kellogg & Sons, Minneapolis, Minn.							
Albert Culver Co.	Rockland	35.01	33.00	6.20	6.00	7.73	9.00
Average		34.50	—	6.74	—	7.76	—

GLUTEN MEAL.

Definition. Gluten meal is a product obtained in the manufacture of starch and glucose from corn and consists largely of the hard, flinty portion of the kernel.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Corn Products Refining Co., New York, N. Y.							
Diamond, A. Dodge & Sons, Corp.	Beverly	41.33	40.00	0.97	1.50	3.32	4.00
Diamond, Mackenzie & Winslow, Inc.	Fall River	41.33	40.00	1.67	1.50	2.50	4.00
Diamond, W. J. Meek	Fall River	41.63	40.00	1.50	1.50	2.80	4.00
Diamond, G. F. Wetherbee Co.	Gardner	40.63	40.00	2.77	1.50	0.84	4.00
Diamond, W. G. Horton	Ipswich	39.67	40.00	3.35	1.50	2.18	4.00
Diamond, Horvitz Grain Co	New Bedford	41.03	40.00	3.33	1.50	2.70	4.00
Diamond, I. J. Rowell	Pepperell	44.39	40.00	1.80	1.50	2.08	4.00
Diamond, I. Morton & Co.	Plymouth	41.07	40.00	1.27	1.50	3.36	4.00
Diamond, Albert Culver Co.	Rockland	45.79	40.00	2.98	1.50	0.97	4.00
Average		41.88	—	2.18	—	2.31	—

GLUTEN FEED.

Definition. Gluten feed is a product obtained in the manufacture of starch and glucose from corn, and consists largely of the flinty portion of the kernel and corn bran.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
American Maize Products Co., New York, N. Y.							
Cream of Corn, G. W. King	Charlton	27.84	23.00	1.89	2.50	6.90	8.50
Cream of Corn, O. F. Metcalf & Sons	Franklin	25.22	23.00	2.60	2.50	7.62	8.50
Cream of Corn, W. O. Gilbert	Lee	26.71	23.00	1.67	2.50	6.96	8.50
Cream of Corn, Prentiss, Brooks & Co.	Holyoke	26.88	23.00	2.17	2.50	6.90	8.50
Cream of Corn, F. H. Crane & Sons	Quincy Adams	25.04	23.00	2.48	2.50	7.00	8.50
Cream of Corn, Ropes Bros.	Salem	26.85	23.00	3.35	2.50	6.48	8.50
Clinton Sugar Refining Co., Clinton, Iowa.							
Clinton, G. M. Foster	Lowell	25.70	20.00	3.15	3.00	6.80	8.00
Clinton, J. Franks	New Bedford	26.62	20.00	3.98	3.00	6.65	8.00
Clinton, Worcester Hay & Gr. Co.	N. Brookfield	27.49	20.00	3.12	3.00	6.45	8.00
Clinton, J. B. Bridges & Co.	S. Deerfield	27.37	20.00	3.31	3.00	7.70	8.00
Corn Products Refining Co., New York, N. Y.							
Buffalo, Eastern Grain Co.	Bridgewater	27.32	23.00	2.69	2.00	7.44	8.50
Buffalo, Ropes Bros.	Danvers	26.76	23.00	4.53	2.00	7.24	8.50
Buffalo, Dresser Hull Co.	Lee	27.32	23.00	4.22	2.00	5.63	8.50
Buffalo, Conant & Co.	Littleton	26.97	23.00	1.60	2.00	6.55	8.50
Buffalo, Knight Grain Co.	Newburyport	26.01	23.00	3.01	2.00	6.62	8.50
Buffalo, J. O. Dean Co.	S. Easton	26.71	23.00	2.12	2.00	6.04	8.50
Buffalo, G. H. Reed	W. Acton	27.28	23.00	3.37	2.00	6.30	8.50
Buffalo, C. H. Mead & Co.	W. Acton	28.37	23.00	4.63	2.00	6.15	8.50
Buffalo, F. Diehl & Son	Wellesley	26.36	23.00	2.68	2.00	7.10	8.50
Buffalo, W. K. Gilmore & Sons	Wrentham	27.09	23.00	1.90	2.00	7.03	8.50
Crescent, J. Burkhardt	Beverly	27.02	23.00	2.21	2.00	7.27	8.50
Globe, A. Dodge & Sons, Corp.	Beverly	25.71	23.00	2.65	2.00	6.18	8.50
Globe, Mackenzie & Winslow, Inc.	Fall River	27.32	23.00	1.95	2.00	6.43	8.50
Curley Bros., Wakefield, Mass.							
Boston, Curley Bros.	Wakefield	25.48	24.00	5.01	3.00	6.32	—
Boston, Curley Bros.	Wakefield	26.79	24.00	2.40	3.00	7.13	—
Douglas & Co., Cedar Rapids, Iowa.							
Cedar Rapids, Jacobson Bros.	N. Dartmouth	24.44	20.00	2.43	2.00	6.70	8.00
Cedar Rapids, M. H. Rolfe, Est.	Newburyport	22.86	23.50	4.40	2.40	6.82	7.50
Huron Milling Co., Harbor Beach, Mich.							
Jenks', C. A. Ketchum	Salem	24.87	23.00	4.62	3.00	6.08	8.00
Jenks', J. F. Hunt	Swampscott	24.61	23.00	5.05	3.00	5.96	8.00
Jenks', J. F. Hunt	Swampscott	25.01	23.00	4.00	3.00	6.64	8.00
J. E. Soper Co., Boston, Mass.							
Bay State, W. H. Garland	Gloucester	22.37	20.00	2.15	2.00	6.52	8.00

GLUTEN FEED (Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
			%	%	%	%	%	%
A. E. Staley Manufacturing Co., Decatur, Ill.								
Staley's,	J. H. Nye	Brockton	24.92	23.00	3.90	2.00	7.38	12.00
Staley's,	T. H. Emerson	E. Weymouth	22.29	23.00	4.70	2.00	7.88	12.00
Staley's,	F. Gauvin	Marlboro	24.61	23.00	1.66	2.00	6.74	12.00
Staley's,	Thorne Bros.	Millis	24.17	23.00	2.41	2.00	7.54	12.00
Staley's,	A. Carr	Northboro	22.24	23.00	2.93	2.00	6.72	12.00
Staley's,	L. H. Kirk	Wakefield	26.71	23.00	2.91	2.00	6.52	12.00
Union Starch & Refining Co., Edinburg, Ind.								
Union,	E. W. Brayman	Lee	25.53	24.00	3.64	3.00	7.08	6.30
Union,	G. M. Foster	Lowell	22.59	24.00	5.06	3.00	7.23	6.30
Union,	G. M. Foster	Lowell	22.77	24.00	5.83	3.00	6.98	6.30
Union,	Loham Bros.	Marblehead	26.15	24.00	4.57	3.00	7.17	6.30
	Average		25.71	—	3.24	—	6.77	—

DISTILLERS' DRIED GRAINS.

Definition. Distillers' dried grains are the dried residue obtained from cereals in the manufacture of alcohol and distilled liquors.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Ajax Milling & Feed Co., New York, N. Y.								
Ajax Flakes,	C. S. Barber	Bernardston	29.33	30.00	8.68	11.00	11.89	14.00
Ajax Flakes,	Eastern Grain Co.	Bridgewater	31.41	30.00	9.71	11.00	11.38	14.00
Ajax Flakes,	J. H. Nye	Brockton	31.24	30.00	10.20	11.00	12.13	14.00
Ajax Flakes,	L. P. Adams	Dalton	28.46	30.00	10.51	11.00	13.24	14.00
Ajax Flakes,	H. K. Webster Co.	Lawrence	32.23	30.00	11.96	11.00	11.42	14.00
Ajax Flakes,	W. N. Potter Grain Co.	Princeton	31.26	30.00	10.44	11.00	11.00	14.00
Ajax Flakes,	Morse Bros.	Southbridge	30.91	30.00	10.04	11.00	12.05	14.00
Ajax Flakes,	Morse Bros.	Southbridge	29.94	30.00	10.29	11.00	12.78	14.00
Ajax Flakes,	H. C. Puffer Co.	Springfield	28.02	30.00	10.10	11.00	11.56	14.00
Ajax Flakes,	H. C. Puffer Co.	Springfield	29.73	30.00	10.72	11.00	11.63	14.00
Ajax Flakes,	C. L. Beals & Co.	Winchester	32.58	30.00	12.83	11.00	11.96	14.00
Atlantic Export Co., Chicago, Ill.								
Atexco Flaky,	Eastern Grain Co.	Bridgewater	23.63	30.00	11.02	10.00	14.67	13.00
Atexco Flaky,	J. B. Garland & Son	Worcester	28.81	30.00	11.32	10.00	14.07	13.00
J. W. Biles Co., Cincinnati, Ohio.								
Dearborn,	C. L. Marsh	Webster	*25.04	22.00	7.02	8.00	11.50	15.00
Fourex,	W. E. Bryant & Co.	Brockton	30.62	31.00	10.63	12.00	9.78	13.00
Fourex,	E. C. Packard	Brockton	31.44	31.00	11.40	12.00	9.34	13.00
Fourex,	Mackenzie & Winslow, Inc.	Fall River	32.60	31.00	11.27	12.00	12.85	13.00
Fourex,	Bowen & Fuller	Leominster	30.21	31.00	11.33	12.00	12.42	13.05
Fourex,	Potter Bros. Co.	N. Adams	33.10	31.00	11.82	12.00	12.17	13.00
Fourex,	S. L. Davenport & Son	N. Grafton	31.26	31.00	11.43	12.00	9.26	13.00
Fourex,	T. E. Borden	N. Westport	35.29	31.00	11.81	12.00	12.29	13.00
Fourex,	Cutler Grain Co.	S. Framingham	32.31	31.00	12.87	12.00	10.53	13.00
Fourex,	Cutler Grain Co.	S. Framingham	31.75	31.00	10.85	12.00	10.45	13.00
Continental Cereal Co., Peoria, Ill.								
Continental,	A. C. Boice	Conway	28.59	29.00	9.55	12.50	8.56	10.50
Continental,	N. Hatfield Grain Co.	N. Hatfield	27.41	29.00	8.78	12.50	7.14	10.50
Continental,	Potter Grain Co.	Shelburne Falls	28.19	29.00	9.75	12.50	8.24	10.50
Continental,	Potter Grain Co.	Shelburne Falls	28.37	29.00	9.49	12.50	7.43	10.50

*Not included in average.

DISTILLERS' DRIED GRAINS (Continued)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Dewey Bros. Co., Blanchester, Ohio.							
Eagle 3 D, ... A. F. Sanctuary	Amherst	34.50	30.00	12.23	10.00	11.08	13.00
Eagle 3 D, ... F. F. Woodward Co	Fitchburg	31.00	30.00	7.92	10.00	10.02	13.00
Eagle 3 D, ... H. C. Puffer Co	Springfield	33.19	30.00	11.82	10.00	11.44	13.00
Eagle 3D, ... H. C. Puffer Co	Springfield	30.91	30.00	12.75	10.00	12.04	13.00
Corn 3 D, ... Brockelman Bros.	Clinton	*24.61	26.00	8.85	9.00	7.33	13.00
Corn 3 D, ... Marlboro Grain Co	Marlboro	*22.42	26.00	7.84	9.00	7.73	13.00
Corn 3 D, ... I. J. Rowell	Pepperell	*23.47	26.00	7.82	9.00	7.73	13.00
Hottelet Co., Milwaukee, Wis.							
Hector, ... A. F. Sanctuary	Amherst	32.14	30.00	11.27	10.00	12.57	14.00
Hector, ... A. Carr	Northboro	32.49	30.00	10.26	10.00	12.83	14.00
Hector, ... J. Cushing & Co	Fitchburg	32.31	30.00	9.98	10.00	14.03	14.00
Hector, ... J. Cushing & Co	Winchendon	35.11	30.00	10.60	10.00	12.50	14.00
Rye, ... Bedford Coal & Grain Co.	Bedford	*14.10	16.00	3.99	8.00	14.00	14.00
Average		31.04	—	10.75	—	11.37	—

*Not included in average.

MALT SPROUTS.

Definition. Malt sprouts consist of the dried sprouts of the barley grain removed after the process of malting.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
American Malting Co., Buffalo, N. Y.							
E. A. Cowee	Jefferson	26.13	25.00	0.97	2.00	13.82	14.00
Atlantic Export Co., Chicago, Ill.							
Ropes Bros	Salem	27.74	22.00	1.37	1.00	13.65	16.00
Chas. M. Cox Co., Boston, Mass.							
C. O. Parmenter & Co	S. Sudbury	28.98	25.00	1.34	1.50	11.33	14.00
Husted Milling Co., Buffalo, N. Y.							
J. B. Bridges & Co	S. Deerfield	27.32	15.63	0.89	1.54	13.72	15.70
Average		27.55	—	1.14	—	13.13	—

BREWERS' DRIED GRAINS.

Definition. Brewers' dried grains are the dried residue obtained from cereals in the manufacture of malted liquors.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Farmers Feed Co., New York, N. Y.							
A. B. Dunham.	Sheffield	24.96	27.20	6.23	6.30	10.44	17.20
James Hanley Brewing Co., Providence, R. I.							
C. O. Parmenter & Co	S. Sudbury	22.94	20.00	5.84	7.00	15.98	18.00
G. H. Reed.	S. Acton	22.47	20.00	6.55	7.00	16.15	18.00
Husted Milling Co., Buffalo, N. Y.							
C. F. Pease	Chester	25.48	27.00	6.92	6.30	13.58	17.00
Providence Brewing Co., Providence, R. I.							
W. L. Palmer	Medway	29.86	25.00	6.70	6.00	11.26	15.00
F. A. Fales & Co	Norwood	28.02	25.00	5.58	5.00	15.28	15.00
F. A. Fales & Co	Norwood	23.96	22.00	5.40	6.00	15.35	—
Weld & Beck	Southbridge	24.61	25.00	6.35	5.00	14.06	15.00
Weld & Beck	Southbridge	28.37	25.00	6.79	5.00	13.60	15.00
Average		25.63	—	6.93	—	13.96	—

WHEAT MIDDLINGS.

Definition. Wheat middlings consists of the finer portions of the wheat kernel as separated from it in the manufacture of flour. While there is no marked line of difference wheat middlings can be placed in one of three classes depending upon the amount of flour present; red dog or low grade flour, white or flour middlings, and standard middlings.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Atlas Flour Mills, Milwaukee, Wis.							
Atlas, M. G. Horton	Ipswich	18.74	16.00	5.29	4.50	6.24	8.00
Atlas, C. A. Ketchum & Co.	Salem	18.16	16.00	5.02	4.50	7.68	9.50
Amendt Milling Co., Monroe, Mich.							
C. H. Laflin	Brookfield	19.09	15.00	5.42	5.00	4.50	4.30
Bay State Milling Co., Winona, Minn.							
Red Dog, Brockelman Bros.	Clinton	18.52	18.00	5.05	5.00	1.95	3.00
Red Dog, Warren Grain Co.	Warren	17.95	18.00	4.43	5.00	1.66	3.00
Winona, A. J. Richards & Son	Weymouth	17.64	17.00	5.50	5.00	8.05	8.00
Benson Roller Mills, Benson, Minn.							
Ropes Bros.	Salem	17.78	—	5.27	—	5.70	—
Berger-Crittenden Milling Co., Milwaukee, Wis.							
Badger Standard, Albert Culver Co.	Rockland	19.31	17.00	5.13	4.00	7.75	9.50
A. H. Brown & Bros., Boston, Mass.							
Standard, C. G. Jordan	Weymouth	17.78	17.00	6.02	4.00	7.16	8.00
H. C. Cole Milling Co., Chester, Ill.							
Prentiss, Brooks & Co.	Westfield	16.20	16.00	4.07	5.00	3.27	5.50
Wm. A. Coombs Milling Co., Coldwater, Mich.							
Wilder & Wotton	Lowell	16.90	15.00	4.67	3.00	6.83	9.00
Chas. M. Cox Co., Boston, Mass.							
Rex, F. H. Emerson	E. Weymouth	17.25	—	5.63	—	6.95	—
Rex, Bowen & Fuller	Leominster	16.55	15.00	4.99	4.50	8.01	8.00
Wirthmore, F. H. Crane & Sons	Quincy Adams	16.59	15.00	4.68	4.00	5.53	5.00
Wirthmore, P. W. Eaton & Co.	Williamstown	17.08	15.00	4.61	4.00	6.13	5.00
Crescent Milling Co., Fairfax, Minn.							
Crescent, H. C. Bowen & Son	Cheshire	18.13	17.62	5.93	5.36	7.45	9.78
Crookston Milling Co., Crookston, Minn.							
J. B. Garland & Son	Worcester	19.35	17.50	6.10	5.80	6.45	6.50
Duluth Superior Mlg. Co., Duluth, Minn.							
Standard, F. H. Emerson	E. Weymouth	17.99	17.50	5.77	5.50	7.60	8.00
White (Pig), G. F. Wetherbee Co.	Gardner	18.04	16.75	5.25	5.00	6.13	7.00
Eagle Roller Mills Co., New Ulm, Minn.							
Superb Red Dog, J. Cushing & Co.	Fitchburg	20.58	19.82	6.00	5.93	3.85	4.30
Superb Red Dog, H. C. Puffer Co.	Springfield	20.93	19.82	6.12	5.93	3.79	4.30
N. Adams Flour & Gr. Co.	N. Adams	17.25	16.40	5.45	5.02	8.01	10.23
Federal Milling Co., Lockport, N. Y.							
Lucky Flour, C. T. Wyman	Hubbardston	18.43	18.00	5.73	5.00	5.43	9.00
Lucky Flour, H. Bruckman	S. Lawrence	18.83	18.00	5.37	5.00	6.40	9.00
Lucky Flour, E. A. Cowee	Worcester	18.65	18.00	5.21	5.00	6.36	9.00
Gardner Mills, Hastings, Minn.							
Snowball, Peterson Coal & Gr. Co.	Gt. Barrington	17.43	15.00	5.32	4.00	5.02	7.50
Snowball, H. J. Williams	Lowell	16.38	15.00	6.19	4.00	6.79	7.50

WHEAT MIDDLINGS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Groton Milling Co., Groton, S. Dakota.							
Standard, ...Jacob Burkhardt.........	Beverly.........	18.91	16.00	6.29	5.00	5.44	7.00
Hecker-Jones-Jewell Mill. Co., New York, N. Y.							
H, ...Eastern Grain Co.........	Bridgewater.....	17.90	17.81	4.57	6.40	7.50	5.70
J. A. Hinds & Co., Rochester, N. Y.							
Standard, ...Beaver Coal & Gr. Co....	Norwood.......	19.61	17.50	6.77	5.30	4.68	7.50
Hubbard Milling Co., Mankato, Minn.							
Standard, ...F. F. Woodward Co......	Fitchburg.......	17.95	14.50	5.95	5.10	7.85	10.00
Hunter-Robinson-Wenz Milling Co., St. Louis, Mo							
Saxony, ...J. B. Garland & Son......	Worcester.......	16.90	15.00	4.51	4.00	4.40	6.00
J. J. Jones, Hankinson, N. Dakota.							
Prentiss, Brooks & Co....	Holyoke........	17.08	20.00	4.93	5.80	6.71	5.68
Lyon & Greenleaf, Wauseon, Ohio.							
Waseo, ...C. S. Barber.............	Bernardston.....	17.34	16.00	4.69	4.00	5.06	6.00
Waseo, ...C. S. Barber.............	Bernardston.....	17.34	16.00	4.72	4.00	5.41	6.00
Medina Milling & Elevator Co., Medina, N. D.							
Medina, ...Cutler Grain & Coal Co...	Palmer.........	16.64	17.80	5.56	4.20	6.70	7.50
New England Flour Co., Boston, Mass.							
Powerful Red Dog, . D. W. Foskett..........	Brimfield.......	16.81	14.00	2.61	—	1.61	5.50
Powerful Standard . G. F. Wetherbee Co.......	Gardner........	18.26	16.00	5.85	4.00	7.50	10.00
Powerful, ...Blood Bros...............	Medford........	19.44	14.00	5.17	3.50	6.57	4.50
Powerful, Standard . Palmer Coal & Grain Co...	Palmer.........	17.51	15.75	3.80	5.25	6.05	10.00
Powerful, Standard, . J. Paull & Co...........	Taunton........	16.67	15.75	4.95	5.25	7.30	10.00
New Prague Flouring Mills Co., N. P., Minn.							
Seal of Minn. Stand. C. Parkinson	Seekonk........	18.87	17.75	5.70	5.80	6.43	6.75
Northwestern Con. Mill Co., Minneapolis, Minn.							
XXX Comet, ...G. Methe & Sons......	Springfield......	20.66	16.50	6.01	4.00	2.44	3.00
Pillsbury Flour Mills Co., Minneapolis, Minn.							
A................M. E. Ballou & Son......	Becket.........	17.43	15.00	4.82	4.50	5.54	6.00
B................Mackenzie & Winslow, Inc.	Fall River......	16.29	15.00	5.30	4.50	8.98	8.00
B................Mackenzie & Winslow, Inc.	Fall River......	14.70	15.00	6.27	4.50	10.50	8.00
XX Daisy Flour, ... Mansfield Mlg. Co.......	Mansfield.......	19.53	16.00	5.29	4.50	3.36	4.00
XX Daisy, ...M. H. Rolfe Estate......	Newburyport....	18.22	16.00	4.82	4.50	3.33	4.00
Pipestone Milling Co., Pipestone, Minn.							
Standard, ...W. J. Meek.............	Fall River......	19.53	17.00	6.33	5.00	6.39	7.00
Quality Mills, Enterprise, Kansas.							
A. H. Wood & Co........	Framingham....	19.61	16.65	4.82	4.75	6.04	—
Red Wing Milling Co., Red Wing, Minn.							
Bixota, ...Stanley Wood Grain Co...	Taunton........	19.61	17.00	5.98	4.00	5.53	9.70
Rush City Milling Co., Rush City, Minn.							
Choice Standard, ... Mackenzie&Winslow, Inc..	New Bedford....	17.43	13.20	4.63	4.20	5.44	8.20
Russell-Miller Milling Co., Minneapolis, Minn.							
Standard, ...J. Paull & Co...........	Taunton........	18.18	15.00	6.12	4.00	7.19	9.00

WHEAT MIDDLINGS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Star & Crescent Milling Co., Chicago, Ill.							
Red Star Red Dog,. H. C. Bowen & Son....	Cheshire........	15.50	16.50	3.11	4.00	2.05	3.00
David Stott, Detroit, Mich.							
Pennant,..........W. Lord,................	Athol...........	16.64	17.00	4.87	5.50	5.77	8.00
Pennant,..........Milford Grain Co.........	Milford.........	16.69	17.00	4.92	5.50	5.97	8.00
Fine White,........W. Lord,................	Athol...........	16.29	16.00	4.71	5.00	4.38	8.00
Fine White,........A. E. Lawrence & Son ...	Ayer...........	16.90	16.00	4.42	5.00	4.43	8.00
Thompson Milling Co., Lockport, N. Y.							
Angelus,..........P. W. Eaton & Co....	Williamstown ...	17.69	17.50	5.33	5.00	5.44	10.00
Valley City Milling Co., Grand Rapids, Mich.							
Farmers Favorite,..Prentiss, Brooks & Co....	Easthampton....	15.76	14.79	4.48	4.25	5.30	7.50
Washburn & Crosby Co., Minneapolis, Minn.							
Standard,.........Bryant & Soule,.........	Middleboro.....	17.43	15.00	5.24	4.00	7.58	8.00
Western Star Mill Co., Salina, Kansas.							
Star,.............F. H. Crane & Sons.....	Quincy Adams...	18.91	17.00	3.91	4.00	3.60	5.50
Williston Mill Co., Williston, N. Dakota.							
W. L. Palmer.........	Medway........	17.08	—	5.93	—	5.62	—
Yukon Mill & Grain Co., Yukon, Oklahoma.							
J. B. Bridges & Co.......	S. Deerfield.....	19.79	15.50	3.29	3.50	4.12	5.00
Average		17.83	—	5.17	—	5.76	—

WHEAT MIXED FEEDS.

Definition. Wheat mixed feed is a mixture of the products other than the flour obtained from the milling of the wheat berry.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar	Fiber. Found.	Fiber. Guar.
Acme-Evans Co., Minneapolis, Minn.							
Acme,............M. G. Williams..........	Raynham.......	21.36	16.50	4.23	4.00	7.36	9.00
Acme,............F. Diehl & Son	Wellesley.......	17.25	16.50	4.20	4.00	8.18	9.00
Acme,............P. W. Eaton & Co. ...	Williamstown ...	17.16	16.50	4.04	4.00	7.31	9.00
Amendt Milling Co., Monroe, Mich.							
Amco,............C. H. Laflin.......	Brookfield......	16.73	16.50	4.47	4.40	7.50	7.50
Annan, Burg & Co., St. Louis, Mo.							
A. B. C.,..........M. G. Williams......	Raynham.......	16.19	14.00	4.87	4.00	7.58	—
A. B. C...........G. H. Reed............	W. Acton.......	16.55	14.00	4.80	4.00	7.63	—
Ansted & Burk Co., Springfield, Ohio.							
Knight Grain Co.........	Newburyport....	16.20	14.50	4.46	3.50	7.66	11.50
E. W. Bailey & Co., Montpelier, Vt.							
J. E. Merrick & Co.......	Amherst........	16.46	16.00	4.26	3.75	7.79	8.50
Bemmels Milling Co., Lisbon, N. Dakota.							
C. B. Sampson..........	Holyoke........	15.41	14.00	5.63	5.00	7.41	8.00

WHEAT MIXED FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Wm. C. Brett, N. Abington, Mass.							
All Right, ... W. C. Brett	N. Abington	16.81	15.00	4.55	4.00	6.23	—
Cavalier Milling Co., Cavalier, N. Dakota.							
F. A. Fales & Co.	Norwood	17.48	16.00	4.75	3.80	6.88	10.50
C. B. Sawin & Son	Southboro	17.95	16.00	4.80	3.80	7.18	10.50
Claro Milling Co., Lakeville, Minn.							
Claro, ... A. H. Wood & Co.	Framingham	17.34	16.00	5 45	3.00	8.08	11.00
Wm. A. Coombs Milling Co., Coldwater, Mich.							
Wilder & Wotton	Lowell	16.86	15.00	4.57	3.00	8.28	10.00
Chas. M. Cox Co., Boston, Mass.							
Paragon, ... E. H. Emerson	E. Weymouth	15.33	14.50	4.23	4.00	7.22	10.00
Paragon, ... H. L. Patrick	Hopedale	16.38	14.50	4.36	4.00	8.56	10.00
Paragon, ... C. B. Sawin & Son	Southboro	16.29	14 50	3.77	4.0C	5.07	10.00
Paragon, ... C. B. Sawin & Son	Southboro	16.20	14.50	3.80	4.00	5.27	10.00
Regent, ... Scott Grain Co.	Amesbury	17.34	15.00	4.47	3.00	8.20	10.00
Regent, ... Lummus & Parker	Danversport	17.81	15.00	5.26	3.00	8.12	10.00
Regent, ... S. R. Carter	W. Berlin	17.95	15.00	4.92	3.00	7.13	10.00
Wirthmore, ... Eastern Grain Co.	Bridgewater	16.99	16.00	5.32	4.00	7.07	7.00
Wirthmore, ... T. H. Emerson	E. Weymouth	17.16	16.00	4.73	4.00	6.26	7.00
Wirthmore, ... G. A. Fair	Holliston	17.60	16.00	5.43	4.00	6.60	7.00
Wirthmore, ... Whitney Coal & Grain Co.	N. Adams	17.60	16.00	4.71	4.00	6.10	7.00
Wirthmore, ... I. J. Rowell	Pepperell	17.25	16.00	5.12	4.00	6.24	7.00
Wirthmore, ... M. G. Williams	Raynham	16.32	16.00	4.50	4.00	7.08	7.00
Wirthmore, ... M. G. Williams	Raynham	17.78	16.00	5.47	4.00	6.92	7.00
Wirthmore, ... W. K. Gilmore & Sons, Inc.	Walpole	17.69	16.00	5.51	4.00	6.97	7.00
J. G. Davis Co., Rochester, N. Y.							
Granite, ... D. W. Foskett	Brimfield	17.08	14.50	5.60	4.00	7.38	11.00
Duluth-Superior Milling Co., Duluth, Minn.							
Boston, ... Potter & Co.	Athol	17.25	15.00	4.85	4.00	7.96	9.50
Boston, ... A. E. Lawrence & Son	Ayer	16.29	16.00	6.33	4.50	7.69	9.50
Boston, ... Nathan Tufts & Sons	Charlestown	17.43	15.00	4.94	4.00	7.86	9.50
Boston, ... Prentiss, Brooks & Co.	Easthampton	16.46	15.00	4.75	4.00	8.18	9.50
Boston, ... N. Paquin & Sons	Fall River	17.08	15.00	4.94	4.00	8.22	9.50
Boston, ... G. F. Wetherbee Co.	Gardner	17.16	15.00	4.95	4.00	7.45	9.50
Boston, ... C. P. Washburn	Middleboro	16.73	15.00	5.42	4.00	7.73	9.50
Boston, ... Plummer & JenningsGr.Co	New Bedford	16.10	15.00	4.67	4.00	7.95	9.60
Boston, ... Warner Bros.	Sunderland	16.90	15.00	5.21	4.00	8.34	9.60
Boston, ... C. H. Mead & Co.	W. Acton	16.9C	15.00	4.45	4.00	8.75	9.50
Eagle Roller Mills, Inc., Lawrenceburg, Ky.							
Eagle, ... W. G. Horton	Ipswich	16 28	—	3.97	—	5.83	—
Everett Aughenbaugh & Co., Waseca, Minn.							
Eaco, ... Plummer & Jennings Gr.Co	New Bedford	17.72	14.00	4.60	3 00	7.45	12.00
Eaco, ... N. Hatfield Grain Co.	N. Hatfield	17.16	14.00	5.05	3.00	8.57	12.00
Federal Milling Co., Lockport, N. Y.							
Lucky, ... M. Callahan & Co.	Holyoke	16.90	16.00	5.58	4.50	7.95	8.50
Lucky, ... M. Callahan & Co.	Holyoke	17.86	16.00	4.62	4.50	6.94	8.50
Fraser-Smith Co., Minneapolis, Minn.							
Yankee, ... O. F. Metcalf & Son	Franklin	15.50	16.00	5.16	4.20	7.79	8.00
Yankee, ... J. B. Garland & Son	Worcester	15.68	16.00	5.01	4.20	6.77	8.00

WHEAT MIXED FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Garland Milling Co., Greensburg, Ind.							
Garland, Eastern Grain Co.	Bridgewater	15.85	15 25	4.22	3.75	7.50	9.00
Garland, Ropes Bros.	Danvers	17.20	15.25	4 13	3.75	7.57	9.00
Garland, F. F. Woodward Co.	Fitchburg	15.94	15.25	4.18	3.75	9.64	9.00
J. B. Garland & Son, Worcester, Mass.							
Royal Worcester, J. B. Garland & Son	Worcester	17.43	16 00	5 32	4 50	6.25	7 00
Glen Mills Cereal Co., Rowley, Mass.							
Glen Mills Cereal Co.	Rowley	15.85	15.00	4 17	4.00	7.30	8 00
Glen Mills Cereal Co.	Rowley	15 06	15 00	3 85	4 00	7 83	8 00
Gopher State Milling Co., Little Falls, Minn.							
Royal, G. M. Foster	Lowell	17.86	14 02	5 14	4.03	7.42	9 00
Grafton Roller Mills, Grafton, N. Dakota.							
Grafton, Prentiss, Brooks & Co.	Holyoke	17.21	15.40	4.93	4.50	6.84	9 30
Grafton, Mansfield Milling Co.	Mansfield	15.84	15.50	4.82	5.00	8.00	11.00
Grafton, Mackenzie & Winslow, Inc.	New Bedford	15.53	15.50	4.77	4.19	5.00	11.90
Grafton, Plummer & Jennings Gr. Co	New Bedford	17.08	15.40	4.91	4.50	7.35	9.30
Grafton, A. M. Reed	N. Westport	16.99	15 40	4.37	4.50	6.37	9.30
Grafton, Whitman Coal & Grain Co.	Whitman	17.16	15.40	5.16	4.50	7.50	9.30
H. L. Halliday, Cairo, Ill.							
C. P. McClanathan	Barre Plains	16.20	14.50	4.04	4.00	7.43	8.00
W. L. Palmer	Medway	15.85	14.50	3.99	4.00	9.26	8.00
F. A. Fales & Co.	Norwood	15.62	14.50	4.13	4.00	7.93	8.00
A. Milot & Sons	Taunton	15.68	14.50	3.93	4.00	8.69	8.00
A. Milot & Sons	Taunton	14.57	14.50	3.66	4.00	7.13	8.00
Harter Milling Co., Toledo, Ohio.							
Weld & Beck	Southbridge	16.46	16.00	4 91	5.00	7.01	7 25
Hoffman Mills, Enterprise, Kansas.							
Fanchon, A. H. Wood & Co.	Framingham	17.69	14 70	4 37	4.45	7.65	10.00
Hunter-Robinson-Wenz Mlg. Co., St. Louis, Mo.							
Sunshine, A. E. Lawrence & Son	Ayer	15.33	14.50	4.33	4.00	7.56	8.00
Sunshine, H. C. Bowen & Son	Cheshire	16.46	14.50	4.05	4.00	7.43	8.00
Sunshine, E. J. Adams	Gt. Barrington	17.51	14.50	4.15	4.00	7.34	8.00
Sunshine, Plummer & Jennings Gr. Co	New Bedford	15.09	14.50	3.75	4.00	7.68	8.00
Sunshine, G. H. Reed	S. Acton	16.90	14.50	4.30	4.00	7.23	8.00
C. P. McClanathan	Barre Plains	18.65	14.50	4.23	4.00	7.58	8.00
Kalispell Flour Mill Co., Kalispell, Mont.							
J. Frank Kirk	New Bedford	15.62	15.00	4 60	4.00	7.75	8.00
Kehlor Flour Mills Co., St. Louis, Mo.							
Kehlor's, Griffin Bros.	Fall River	17.86	14.50	4.41	4.00	7.50	8.00
Kehlor's, A. M. Reed	N. Westport	16.23	14.50	4.68	4.00	7.05	8.00
Kehlor's, A. Milot & Son	Taunton	18.39	14.50	4.24	4.00	7.79	8.00
Kemper Mill & Elevator Co., Kansas City, Mo.							
Anchor, Rollstone Grain Co.	Fitchburg	17.30	16.00	4.46	4.00	7.40	10.00
Crescent, G. C. Turner	Chester	17.08	16.00	3.97	4.00	7.59	10.00
Crescent, J. F. Hunt	Swampscott	16.81	16.00	4.12	4.00	7.22	10.00

WHEAT MIXED FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Lawrenceburg Roller Mills, Lawrenceburg, Ind.							
Snow Flake,........J. Cushing & Co.........	Hudson.........	15.55	15.20	3.83	4.30	7.35	8.00
Snow Flake,........Plummer & Jennings Gr.Co	New Bedford....	15.85	15.20	4.12	4.30	7.63	8.00
Snow Flake,........Plummer & Jennings Gr.Co	New Bedford....	15.53	15.20	3.60	4.30	4.38	8.00
Snow Flake,........F. H. Crane & Sons......	Quincy Adams...	16.14	15.20	4.14	4.30	7.80	8.00
Snow Flake,........F. Dianto...............	Randolph.......	16.20	15.20	4.20	4.30	7.92	8.00
Snow Flake,........J. B. Bridges & Co.......	S. Deerfield.....	15.24	15.20	4.06	4.30	7.24	8.00
Lexington Roller Mills, Lexington, Ky.							
Thoroughbred.....Horvitz Grain Co........	New Bedford....	15.71	16.38	3.90	4.15	5.90	6.91
Thoroughbred.....C. L. Beals & Co.........	Winchendon.....	15.68	16.38	4.01	4.15	7.11	6.91
John F. Meyer & Sons Milling Co., Springfield, Mo							
Model,............Jaquith & Co............	Woburn........	17.16	14.50	3.97	3.50	6.48	8.00
New England Flour Co., Boston, Mass.							
Hiawatha,..........A. B. Dunham...........	Sheffield........	16.99	16.40	4.08	5.00	6.18	11.00
Hiawatha,..........L. A. Snow..............	Upton..........	17.16	15.00	5.33	3.00	7.59	10.00
Powerful,..........W. E. Bryant & Co.......	Brockton.......	17.16	15.00	5.19	4.50	6.89	10.00
Powerful,..........G. W. King.............	Charlton........	16.99	13.00	5.35	3.00	7.28	10.00
Powerful,..........C. L. Beals & Co.........	Winchendon....	18.30	15.00	4.63	4.50	7.74	10.00
Niagara Falls Milling Co., Buffalo, N. Y.							
Perfect,...........Worcester Hay & Grain Co	W. Brookfield...	16.55	15.00	4.54	3.00	7.32	8.75
Noblesville Milling Co., Noblesville, Ind.							
E. E. Cole Co............	Billerica........	16.55	15.00	4.20	4.00	6.83	—
Mackenzie & Winslow, Inc.	New Bedford....	16.67	15.00	3.92	4.00	8.25	—
Northw'n Con. Milling Co., Minneapolis, Minn.							
A. F. Sanctuary..........	Amherst........	17.51	15.00	5.71	4.50	7.18	10.00
Planet,............Evans & Bowker.........	Baldwinsville....	19.00	15.00	5.39	4.00	5.43	8.00
Planet,............Bond Grain Co...........	Charlton........	18.30	15.00	5.90	4.00	5.67	8.00
Planet,............W. N. Potter Grain Co. ..	Princeton.......	18.79	15.00	5.74	4.00	5.85	8.00
Planet,............W. N. Potter Grain Co. ..	Princeton.......	19.35	15.00	6.37	4.00	5.75	8.00
Planet,............W. N. Potter's Sons......	Springfield......	17.95	15.00	5.92	4.00	5.28	8.00
Planet,............W. N. Potter's Sons......	Springfield......	17.60	15.00	5.50	4.00	6.18	8.00
Planet,............C. L. Beals & Co.........	Winchendon.....	18.56	15.00	5.76	4.00	5.34	8.00
North Western Feed Co., Minneapolis, Minn.							
Vermont,..........Bond Grain Co...........	Charlton........	16.86	14.00	4.50	4.00	7.12	—
Vermont,..........W. F. Little,............	Worcester.......	16.64	14.00	4.47	4.00	6.91	—
Northwestern Mill. Co., Little Falls, Minn.							
Whitman Coal & Grain Co	Whitman.......	17.78	14.02	4.95	4.08	7.42	8.00
Cummings, Chute & Co...	Woburn........	17.16	14.02	4.43	4.08	7.23	8.00
Noyes & Colby, Boston, Mass.							
New Era,..........Wilson & Holden........	Worcester.......	16.64	16.00	4.79	4.00	7.11	7.00
Pillsbury Flour Mills Co., Minneapolis, Minn.							
Ropes Bros.............	Danvers........	17.65	16.00	4.20	4.50	6.88	8.00
E. A. Cowee............	Jefferson........	17.95	16.00	4.92	4.50	6.96	8.00
E. A. Cowee............	Jefferson........	17.08	16.00	4.76	4.50	7.00	8.00
Bryant & Soule..........	Middleboro.....	17.20	16.00	4.55	4.50	6.92	8.00
Bryant & Soule..........	Middleboro.....	16.81	16.00	4.69	4.50	6.86	8.00
Plummer & Jennings Gr.Co	New Bedford....	17.34	16.00	5.15	4.50	7.58	8.00
I. J. Rowell.............	Pepperell.......	17.95	16.00	4.33	4.50	6.98	8.00
F. Dianto...............	Randolph.......	18.91	16.00	3.14	4.50	5.95	8.00
H. G. Hill Co...........	Williamsburg....	17.04	16.00	4.62	4.50	6.71	8.00

WHEAT MIXED FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Red River Milling Co., Fergus Falls, Minn.							
Hyegrad, ... C. P. Washburn	Middleboro	17.86	14.60	5.20	4.10	7.17	9.90
Royal Milling Co., Great Falls, Mont.							
Royal, ... Scott Grain Co.	Amesbury	17.60	16.00	4.93	4.00	6.67	8.00
Royal, ... Mackenzie & Winslow, Inc.	Fall River	16.29	16.00	4.50	4.00	8.04	8.00
Rush City Milling Co., Rush City, Minn.							
Maxim, ... Potter & Co.	Athol.	16.90	16.00	4.87	4.20	7.08	9.00
Maxim, ... W. N. Potter Grain Co. ..	Princeton	17.60	16.00	4.78	4.20	7.13	9.00
Russell Flour Co., Albany, N. Y.							
A. T. Butler	Adams	17.73	15.00	5.31	4.50	7.03	10.00
A. T. Butler	Adams	17.34	15.00	4.95	4.50	7.90	10.00
E. C. Frost	Shelburne Falls ..	17.43	15.00	5.46	4.50	7.53	10.00
E. C. Frost	Shelburne Falls ..	17.65	15.00	4.84	4.50	7.79	10.00
Russell-Miller Milling Co., Minneapolis, Minn.							
Occident, ... Pierce & Winn	Arlington	17.78	15.00	5.23	4.50	7.79	10.00
Occident, ... A. E. Lawrence & Son	Ayer	17.25	15.00	5.29	4.50	7.43	10.00
Occident, ... A. E. Lawrence & Son	Ayer	14.36	15.00	4.73	4.50	7.53	10.00
Occident, ... Mackenzie & Winslow, Inc.	Fall River	16.99	15.00	5.69	4.50	8.20	10.00
Occident, ... W. J. Meek	Fall River	18.51	15.00	4.37	4.50	6.28	10.00
Occident, ... Prentiss Brooks & Co.	Holyoke	16.90	15.00	5.06	4.50	7.19	10.00
Occident, ... Blood Bros.	Medford	17.25	15.00	5.40	4.50	7.76	10.00
Occident, ... S. R. Carter	W. Berlin	17.16	15.00	5.56	4.50	7.22	10.00
Occident, ... H. E. Thompson	Plainville	18.30	15.00	5.33	4.50	7.38	10.00
Occident, ... H. C. Puffer Co.	Springfield	16.74	15.00	5.33	4.50	7.48	10.00
Occident, ... C. R. Conant	Whitman	16.99	15.00	5.33	4.50	7.78	10.00
Shane Bros. & Wilson Co., Hastings, Minn.							
King Midas, ... Peterson Coal & Grain Co.	Gt. Barrington ..	16.11	15.00	4.91	4.00	7.44	9.50
Sheffield King Milling Co., Minneapolis, Minn.							
Gold Mine, ... Bond Grain Co.	Charlton	17.34	15.00	5.32	4.00	7.69	8.00
Gold Mine .... Bond Grain Co.	Charlton	16.73	15.00	4.94	4.00	7.10	8.00
Gold Mine, ... O. F. Metcalf & Son	Franklin	16.80	15.00	4.80	4.00	8.13	8.00
Gold Mine, ... L. H. Kirk, ...	Wakefield	17.03	15.00	4.97	4.00	7.65	8.00
Gold Mine, ... F. Diehl & Son	Wellesley	17.78	15.00	5.16	4.00	7.18	8.00
Gold Mine, ... J. B. Garland & Son	Worcester	16.99	15.00	4.79	4.00	7.25	9.00
J. E. Soper Co., Boston, Mass.							
Mackenzie & Winslow ...	Fall River	16.10	—	4.40	—	7.10	—
Sparks Milling Co., Alton, Ill.							
Try Me, ... A. T. Knight & Co.	Hudson	17.20	16.00	3.77	4.50	7.00	8.00
Try Me, ... H. K. Webster Co.	Lawrence	17.16	16.00	4.18	4.50	6.96	8.00
Try Me, ... Conant & Co.	Littleton	18.48	16.00	4.38	4.50	7.13	8.00
Try Me, ... H. J. Williams	Lowell	18.21	16.00	4.03	4.50	6.73	8.00
Try Me, ... Mansfield Milling Co.	Mansfield	17.69	16.00	3.90	4.50	6.32	8.00
Try Me, ... C. Parkinson	Seekonk	17.34	16.00	4.05	4.50	7.10	8.00
Wabash, ... Wallace Lord	Athol	15.94	14.00	4.22	3.50	7.29	8.00
Wabash, ... Wallace Lord	Athol	16.11	14.00	4.02	3.50	8.99	8.00
Wabash, ... B. W Brown	Concord	16.42	14.00	3.37	3.50	7.14	8.00
Stanard-Tilton Milling Co., St. Louis, Mo.							
J. B. Bridges & Co.	S. Deerfield	17.60	15.00	4.65	4.00	9.61	—
F. W. Stock & Sons, Hillsdale, Mich.							
Monarch, ... A. T. Knight & Co.	Hudson	17.51	17.00	4.93	4.50	8.08	9.00
Monarch, ... A. M. Reed	N. Westport	17.16	17.00	5.32	4.50	7.50	9.00
Monarch, ... A. M. Reed	N. Westport	17.60	17.00	5.30	4.50	7.94	9.00

WHEAT MIXED FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
David Stott, Detroit, Mich.							
R. W. Davies	Greenfield	16.15	16.00	4.54	5.00	6.56	7.58
Honest, E. J. Adams	Gt. Barrington	16.34	16.50	4.67	5.00	7.45	8.00
Stratton & Co., Concord, N. H.							
F. G. Morey & Co.	Billerica	14.80	15.76	4.42	4.14	6.65	8.00
W. Livingston	Lowell	14.06	15.76	4.13	4.14	6.71	8.00
Thornton & Chester Milling Co., Buffalo, N. Y.							
A. D. Potter	Orange	16.20	14.00	5.23	3.00	7.65	11.00
Waggoner-Gates Milling Co., Independence, Mo.							
J. O. Ellison & Co.	Haverhill	17.51	15.00	4.23	3.00	7.05	9.00
H. L. Patrick	Hopedale	15.76	15.00	4.33	3.00	7.23	9.00
H. G. Hill Co.	Williamsburg	16.81	15.00	4.38	3.00	6.91	9.00
Washburn-Crosby Co., Minneapolis, Minn.							
E. J. Adams	Gt. Barrington	16.29	16.00	5.83	4.50	7.67	9.00
P. Foisy	New Bedford	16.46	16.00	5.52	4.50	8.23	9.00
N. Attleboro Grain Co.	N. Attleboro	16.23	16.00	4.33	4.50	7.43	9.00
Whitney Coal & Grain Co.	N. Adams	17.95	16.00	5.57	4.50	7.73	9.00
Morse Bros.	Southbridge	17.08	16.00	4.92	4.50	7.70	9.00
W. K. Gilmore & Sons, Inc.	Walpole	16.73	16.00	5.73	4.50	8.24	9.00
Webster Mill Co., Webster, S. Dakota.							
Webster, J. H. Nye,	Brockton	16.38	15.30	5.29	4.80	8.81	10.40
Webster, I. Morton & Co.	Plymouth	16.21	15.30	5.24	4.80	8.67	10.40
Webster, W. P. Barney	Seekonk	16.81	15.30	4.83	4.80	7.75	10.40
Webster, J. B. Garland & Son	Worcester	16.64	15.30	5.50	4.80	8.44	10.40
H. Wehman, Minneapolis, Minn.							
Tally Ho, A. Carr	Northboro	17.51	16.00	4.36	4.50	5.45	8.00
Williams Bros. Co., Kent, Ohio.							
Kent, F. F. Woodward Co.	Fitchburg	15.59	12.00	4.06	2.00	6.11	15.00
Kent, Mansfield Milling Co.	Mansfield	15.97	12.00	4.19	2.00	7.03	15.00
Kent, Horvitz Grain Co.	New Bedford	15.68	12.00	4.42	2.00	5.73	15.00
Kent, F. H. Crane & Sons	Quincy Adams	16.67	12.00	4.33	2.00	5.95	15.00
Kent, A. N. Whittemore	Worcester	16.64	12.00	4.48	2.00	6.87	15.00
Average		16.91	—	4.71	—	7.27	—

WHEAT BRAN.

Definition. Wheat bran is the coarse outer coatings of the wheat berry.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber Found.	Fiber Guar.
Amendt Milling Co., Monroe, Mich.							
A. Carr	Northboro	15.41	14.00	3.76	3.00	8.31	9.50
Atlas Flour Mills, Milwaukee, Wis.							
Atlas, C. A. Ketchum & Co.	Salem	16.76	15.00	4.75	3.50	10.31	12.00
Ballard & Ballard Co., Louisville, Ky.							
Ballard's, J. Cushing & Co.	Hudson	15.68	14.50	3.36	4.10	9.25	9.00
Bay State Milling Co., Winona, Minn.							
Winona, A. J. Richards & Son	Weymouth	16.14	15.00	4.97	5.00	10.80	11.00

WHEAT BRAN (Continued)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
A. H. Brown & Bros., Boston, Mass.							
C. G. Jordan	Weymouth	16.20	15.50	5.67	4.75	9.87	11.00
L. G. Campbell Milling Co., Owatonna, Minn.							
Hoosac Val. Coal & Gr. Co.	Adams	15.33	13.40	4.49	4.50	10.29	12.20
C. S. Christensen Co., Madella, Minn.							
H. C. Bowen & Son	Cheshire	15.33	14.60	4.52	4.40	10.62	12.10
George C. Christian, Minneapolis, Minn.							
Jersey, C. P. Washburn	Middleboro	16.55	13.00	5.07	4.00	8.93	11.00
Chas. M. Cox Co., Boston, Mass.							
Dudley, N. Paquin & Sons	Fall River	15.76	15.50	4.67	4.00	10.35	9.00
Dudley, J. P. Thacher	Littleton	15.68	15.50	4.85	4.00	10.38	9.00
Monogram, Prentiss Brooks & Co.	Easthampton	15.94	15.50	4.95	4.00	9.84	9.00
Monogram, Plummer & Jennings Gr. Co	New Bedford	13.90	15.50	4.70	4.00	9.40	9.00
Monogram, I. Morton & Co.	Plymouth	16.03	15.50	4.91	4.00	10.78	9.00
Monogram, C. O. Parmenter & Co.	S. Sudbury	14.45	15.50	4.99	4.00	10.00	9.00
Monogram, S. R. Carter	W. Berlin	14.63	15.50	4.86	4.00	9.97	9.00
Newport, J. B. Bridges & Co.	S. Deerfield	15.68	14.50	4.02	3.50	9.37	11.00
W. K. Gilmore & Sons	Wrentham	15.25	—	4.71	—	7.68	—
Dewey Bros. Co., Blanchester, Ohio.							
C. L. Marsh	Webster	15.50	14.50	3.88	4.00	8.07	9.50
Domestic Flour Milling Co., Kansas City,							
C. H. Laflin	Brookfield	16.81	14.50	3.96	4.00	9.25	10.00
Duluth Universal Milling Co., Duluth, Minn.							
C. T. Wyman	Hubbardston	15.76	14.50	5.25	4.40	10.83	10.50
B. A. Eckhart Milling Co., Chicago, Ill.							
Eastern Grain Co.	Bridgewater	16.67	14.00	4.32	3.00	8.98	—
Excelsior Mill Co., Yankton, S. Dak.							
M. G. Williams	Raynham	17.08	14.00	4.50	2.70	9.45	9.60
Federal Milling Co., Lockport, N. Y.							
Lucky, G. Methe & Sons	Springfield	16.03	17.50	5.60	4.50	9.74	10.00
Groton Milling Co., Groton, S. Dak.							
Hingham Grain Co.	Hingham	16.11	15.00	5.04	4.00	9.91	11.00
Wm. Hamilton & Son, Honeye Falls, N. Y.							
Dexter Root Co.	Springfield	15.24	—	4.03	—	8.70	—
Harvey Milling Co., Harvey, N. Dak.							
N. Tufts & Co.	Charlestown	14.98	15.30	5.36	4.70	9.31	11.60
Hoffman Mills, Enterprise, Kan.							
A. H. Wood & Co.	Framingham	16.46	—	4.25	—	9.09	—
Hubbard Milling Co., Mankato, Minn.							
Mackenzie & Winslow, Inc.	New Bedford	15.79	15.00	4.63	4.80	9.25	11.25
Jennison Bros. & Co., Janesville, Minn.							
Warner Bros.	Sunderland	16.64	15.00	5.07	4.00	9.32	11.00

WHEAT BRAN (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Kehlor's Flour Mills Co., St. Louis, Mo.							
Palace, J. Cushing & Co.	Fitchburg	13.65	14.00	4.46	3.50	8.20	10.00
Palace, F. H. Crane & Sons	Quincy Adams	17.20	14.00	4.56	3.50	9.13	10.00
Kemper Mill & Elevator Co., Kansas City, Mo.							
Anchor, E. A. Cole,	Housatonic	15.06	14.50	3.72	4.00	8.73	10.00
Lyon & Greenleaf, Wauseon, Ohio.							
Waseo, C. S. Barber	Bernardston	15.15	14.50	4.00	4.00	9.35	9.50
Waseo, C. S. Barber	Bernardston	14.80	14.50	3.85	4.00	8.90	9.50
Mankato Milling Co., Mankato, Minn.							
W. Livingston	Lowell	16.29	15.00	4.74	4.80	9.00	11.50
Moseley & Motley Milling Co., Rochester, N. Y.							
T. H. Emerson	E. Weymouth	16.64	14.00	5.51	3.00	9.19	11.00
New Prague Flour. Mill Co., New Prague, Minn							
F. F. Woodward Co	Fitchburg	15.94	14.60	5.06	4.75	10.40	11.00
Northwestern Con. Milling Co., Minneapolis, Minn							
Mackenzie & Winslow, Inc.	Fall River	16.38	14.50	5.95	4.00	9.98	11.00
Bryant & Soule	Middleboro	16.11	14.50	5.83	4.00	10.33	11.00
S. L. Davenport & Son	N. Grafton	16.20	14.50	4.95	4.00	9.83	11.00
Northwestern Milling Co., Little Falls, Minn.							
Ham & Co	Woburn	15.68	12.50	4.86	3.70	9.76	13.10
Phoenix Mill Co., Minneapolis, Minn.							
C. B. Sampson	Holyoke	15.59	14.00	5.33	4.00	10.39	11.70
Pillsbury Mills Co., Minneapolis, Minn.							
C. Parkinson	Seekonk	15.85	14.50	5.07	4.00	9.98	11.00
Quaker City Flour Mills Co., Philadelphia, Pa.							
Quaker City, Mackenzie & Winslow, Inc.	New Bedford	14.19	17.00	4.50	3.50	9.09	8.50
E. C. Frost	Shelburne Falls	15.15	17.00	4.81	3.50	8.51	8.50
Cummings, Chute & Co.	Woburn	14.71	17.00	4.44	3.50	8.17	8.50
Sharon Elevator & Milling Co., Sharon, N. Dak.							
Cutler Grain Co	S. Framingham	16.11	—	4.82	—	9.40	—
Star & Crescent Milling Co., Chicago, Ill.							
A. Dodge & Sons, Corp.	Beverly	16.81	15.00	4.95	4.00	10.11	10.00
Bryant & Soule	Middleboro	16.41	15.00	4.60	4.00	10.53	10.00
W. H. Stokes Milling Co., Watertown, S. Dak.							
Mackenzie & Winslow, Inc.	Fall River	16.32	15.00	4.60	4.00	9.28	9.79
David Stott, Detroit, Mich.							
Rollstone Grain Co.	Fitchburg	16.38	16.00	4.54	4.50	8.74	12.00
Thompson Milling Co., Lockport, N. Y.							
A. Dodge & Sons, Corp.	Beverly	15.94	15.75	5.12	4.75	9.34	10.50

WHEAT BRAN (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Thornton & Chester Milling Co., Buffalo, N. Y.							
W. N. Potter & Co......	Charlemont.....	15.37	14.00	4.67	3.00	9.26	11.00
W. N. Potter Grain Co. .	Princeton.......	15.33	14.00	4.77	3.00	9.45	11.00
Washburn-Crosby Co., Minneapolis, Minn.							
Beaver Coal & Grain Co...	Norwood......	15.27	14.50	4.72	4.00	9.80	11.00
Williamson Milling Co., Clay Center, Kansas.							
D. W. Foskett...........	Brimfield......	17.43	15.50	4.40	3.50	8.25	12.00
Williston Mills Co., Williston, N. Dak.							
Lexington Grain Co......	Lexington......	15.24	16.50	5.17	4.60	9.37	10.20
Average		15.86	—	4.72	—	9.43	—

RYE FEEDS.

Definition. Rye feeds are by-products obtained in the manufacture of flour from rye.

Boutwell Milling & Elevator Co., Troy, N. Y.							
Prentiss, Brooks & Co....	Holyoke........	16.29	13.50	3.08	3.00	3.97	6.00
Pittsfield Grain Co.......	Pittsfield........	15.59	13.50	3.14	3.00	4.15	6.00
Prentiss, Brooks & Co....	Westfield.......	14.19	13.50	2.92	3.00	2.91	6.00
J. B. Garland & Son......	Worcester.......	16.29	13.50	2.86	3.00	3.34	6.00
J. B. Garland & Son......	Worcester.......	15.68	13.50	3.52	3.00	3.99	6.00
Washburn-Crosby Co., Minneapolis, Minn.							
Middlings,.........Bond Grain Co...........	Charlton........	17.21	14.00	3.73	3.00	5.35	6.00

WHEAT FEEDS WITH ADMIXTURES.

Definition. Wheat Feeds with admixtures are wheat products to which has been added material derived from some other source than wheat.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Indiana Milling Co., Terre Haute, Ind.								
Sterling, Mackenzie & Winslow	Fall River	11.56	9.80	3.27	2.75	16.10	16.00	Wheat bran, corn, cob meal.
Sterling, Mackenzie & Winslow	Fall River	10.14	9.80	3.28	2.75	11.45	16.00	
Sterling, Milford Grain Co.	Milford	10.77	9.80	3.36	2.75	13.34	16.00	
Sterling, J. W. Doon & Son	Natick	9.19	9.80	2.80	2.75	18.12	16.00	
Sterling, W. C. Whitcher	Stoneham	10.68	9.80	2.83	2.75	14.20	16.00	
Meech & Stoddard, Middletown, Conn.								
Connecticut, Jacobson Bros.	N. Dartmouth	9.44	9.80	4.47	2.75	15.53	16.00	Wheat bran, corn, cob meal.
Quaker Oats Co., Chicago, Ill.								
Buckeye, Hoosac Val, C. & Gr. Co.	Adams	16.81	13.00	4.20	4.00	7.67	8.00	Wheat bran, wheat feed, rye shorts.
Buckeye, C. S. Barber	Bernardston	17.60	13.00	4.93	4.00	8.11	8.00	
Buckeye, C. S. Barber	Bernardston	17.16	13.00	4.96	4.00	8.37	8.00	
Buckeye, Mackenzie & Winslow	Fall River	17.29	13.00	4.37	4.00	8.80	8.00	
Buckeye, Plummer & Jennings Gr. Co	New Bedford	16.95	13.00	4.69	4.00	8.43	8.00	
Buckeye, H. C. Puffer Co.	Springfield	18.04	13.00	4.83	4.00	7.91	8.00	
Buckeye, Cole Bros.	Swansea	17.03	13.00	4.73	4.00	8.10	8.00	
Buckeye, J. Paull & Co.	Taunton	17.34	13.00	4.53	4.00	7.87	8.00	
A. Waller & Co., Henderson, Ky.								
Blue Grass, H. G. Hill Co.	Williamsburg	10.16	9.00	2.77	2.00	15.62	17.00	Wheat bran, wheat middlings, gd. corn & cob.
Blue Grass, H. G. Hill Co.	Williamsburg	9.81	9.00	2.52	2.00	15.67	17.00	

DAIRY AND HORSE FEEDS (Containing more than 15% protein).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
J. Bibby & Sons, Liverpool, Eng.								
Oil cake Dairy, C. B. Sawin & Son	Southboro	19.79	18.00	6.20	6.00	8.83	11.00	Decorticated and undecorticated cottonseed cake, wheat middlings, corn meal, decorticated and undecorticated peanut cake, rice polish, molasses, soy bean cake, salt, locust beans.
Oil cake Dairy, J. Loring & Co.	Watertown	21.54	18.00	6.62	6.00	9.99	11.00	
Oil cake Dairy, J. Loring & Co.	Watertown	21.28	18.00	6.70	6.00	9.58	11.00	
Oil cake Horse, C. B. Sawin & Son	Southboro	20.31	20.00	7.40	10.00	8.86	11.00	Decorticated and undecorticated cottonseed cake, wheat middlings, corn meal, decorticated and undecorticated pea nut cake, rice polish, molasses, soy bean cake, locust bean, salt.
Oil cake Horse, J. Loring & Co.	Watertown	20.31	20.00	8.72	10.00	8.61	11.00	
Oil cake Horse, J. Loring & Co.	Watertown	13.91	20.00	7.67	10.00	7.30	11.00	

DAIRY AND HORSE FEEDS (Containing more than 15% protein) (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
J. W. Biles Co., Cincinnati, Ohio.								
Union Grains, W. E. Bryant & Co.	Brockton	25.92	24.00	6.99	7.00	9.45	9.00	Distillers grains, cottonseed meal, old process linseed meal, wheat middlings, wheat bran, hominy meal, malt sprouts, salt.
Union Grains, W. E. Bryant & Co.	Brockton	24.39	24.00	6.13	7.00	9.23	9.00	
Union Grains, C. H. Laflin	Brookfield	25.31	24.00	6.63	7.00	8.53	9.00	
Union Grains, Bryant & Soule	Middleboro	25.45	24.00	6.92	7.00	10.28	9.00	
Union Grains, J. O. Ellison & Co.	Haverhill	24.52	24.00	6.67	7.00	9.53	9.00	
Union Grains, Mansfield Milling Co.	Mansfield	24.17	24.00	6.49	7.00	9.21	9.00	
Union Grains, Guay Bros.	New Bedford	25.48	24.00	6.86	7.00	9.69	9.00	
Union Grains, Guay Bros.	New Bedford	25.62	24.00	6.85	7.00	8.75	9.00	
Union Grains, S. L. Davenport & Son	N. Grafton	24.48	24.00	6.87	7.00	8.00	9.00	
Union Grains, S. L. Davenport & Son	N. Grafton	24.83	24.00	6.29	7.00	8.57	9.00	
Union Grains, N. Hatfield Grain Co.	N. Hatfield	24.17	24.00	6.49	7.00	9.01	9.00	
Union Grains, G. Methe & Son	Springfield	23.29	24.00	5.93	7.00	9.33	9.00	
Union Grains, H. C. Puffer Co.	Springfield	23.99	24.00	6.00	7.00	9.02	9.00	
Union Grains, P. W. Eaton & Co.	Williamstown	24.17	24.00	6.32	7.00	9.06	9.00	
Buffalo Cereal Co., Buffalo, N. Y.								
Creamery, A. M. Butler	Avon	18.83	18.00	4.84	4.00	9.26	8.00	Corn, wheat middlings, hominy feed, cottonseed meal, gluten feed, oat hulls.
Creamery, J. H. Nye	Brockton	17.99	18.00	4.88	4.00	8.13	8.00	
Creamery, J. P. Ellison & Co.	Haverhill	19.35	18.00	5.33	4.00	9.41	8.00	
Creamery, A. Culver & Co.	Rockland	19.79	18.00	5.20	4.00	9.00	8.00	
Creamery, A. Culver & Co.	Rockland	18.96	18.00	5.17	4.00	9.55	8.00	
Chapin & Co., Hammond, Ind.								
Unicorn, A. Dodge & Son	Beverly	27.03	26.00	5.03	5.50	9.80	10.00	Corn distillers grains, cottonseed meal, hominy meal, malt sprouts, gluten feed, barley feed, brewers grains, wheat bran, linseed meal.
Unicorn, A. Dodge & Son	Beverly	28.54	26.00	6.44	5.50	9.86	10.00	
Unicorn, J. H. Nye	Brockton	25.22	26.00	4.76	5.50	10.57	10.00	
Unicorn, J. H. Nye	Brockton	26.67	26.00	7.40	5.50	9.45	10.00	
Unicorn, Peterson Coal & Grain Co.	Gt. Barrington	26.01	26.00	5.40	5.50	10.29	10.00	
Unicorn, W. N. Potter Sons & Co.	Hadley	25.66	26.00	5.34	5.50	10.16	10.00	
Unicorn, C. T. Wyman	Hubbardston	26.09	26.00	5.30	5.50	8.79	10.00	
Unicorn, A. N. Whittemore & Co.	Worcester	26.97	26.00	5.83	5.50	9.00	10.00	

DAIRY AND HORSE FEEDS—Containing more than 15% protein (Continued)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber Found.	Fiber Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Chas. M. Cox Co., Boston, Mass.								
Wirthmore, E. A. Cowee Est.	Jefferson	23.91	26.00	5.17	5.00	7.98	9.00	Cottonseed meal, gluten feed, malt sprouts, distillers grains, wheat bran, hominy meal.
Wirthmore, P. Foisy	New Bedford	24.18	26.00	5.52	5.00	8.65	9.00	
Wirthmore, Knight Grain Co.	Newburyport	27.23	26.00	5.93	5.00	8.66	9.00	
Wirthmore, A. Culver Co.	Rockland	25.31	26.00	5.83	5.00	9.10	9.00	
Wirthmore, Warner Bros.	Sunderland	26.71	26.00	6.11	5.00	9.17	9.00	
Wirthmore, P. W. Eaton & Co.	Williamstown	26.62	26.00	5.58	5.00	10.16	9.00	
Wirthmore, C. W. Bowker & Co.	Worcester	26.62	26.00	5.37	5.00	8.08	9.00	
H. O. Co., Buffalo, N. Y.								
Algrane, A. T. Butler	Adams	16.73	14.00	3.85	4.00	10.13	9.00	Oat hulls, wheat middlings, gluten feed, corn, cottonseed meal, oats, oat shorts, salt.
Algrane, A. T. Butler	Adams	18.30	14.00	4.18	4.00	10.23	9.00	
Algrane, Lenox Coal Co.	Lenoxdale	17.51	14.00	3.87	4.00	11.98	9.00	
Husted Milling Co., Buffalo, N. Y.								
Dairy, C. F. Pierce	Chester	23.03	20.00	5.33	4.00	8.82	9.00	Cottonseed meal, corn meal, oat clips, wheat middlings, gluten feed, linseed oil meal, distillers grains, malt sprouts, salt.
Larrowe Milling Co., Detroit, Mich.								
Larro, Bedford Coal & Grain Co.	Bedford	20.58	19.00	2.99	3.00	11.57	14.00	Cottonseed meal, gluten feed, distillers grains, beet pulp, wheat bran, wheat middlings, salt.
Larro, G. F. Wetherbee Co.	Gardner	20.23	19.00	3.57	3.00	13.35	14.00	
Larro, P. Foisy	New Bedford	20.05	19.00	3.24	3.00	12.44	14.00	
Larro, Knight Grain Co.	Newburyport	19.96	19.00	4.79	3.00	12.23	14.00	
Larro, Knight Grain Co.	Newburyport	19.04	19.00	3.26	3.00	12.00	14.00	
Larro, N. Attleboro Grain Co.	N. Attleboro	19.22	19.00	3.15	3.00	12.58	14.00	
Larro, S. L. Davenport & Son	N. Grafton	21.63	19.00	3.60	3.00	11.24	14.00	
Larro, A. Culver Co.	Rockland	20.40	19.00	3.42	3.00	11.63	14.00	
Larro, Taunton Grain Co.	Taunton	21.01	19.00	3.46	3.00	12.18	14.00	
Ropes Bros., Salem, Mass.								
Ropes Horse, Ropes Bros.	Danvers	17.86	13.00	5.78	5.50	9.57	9.50	Hominy meal, oats, linseed oil meal, wheat mixed feed, gluten feed, alfalfa meal.
Ropes Horse, Ropes Bros.	Salem	15.27	13.00	4.47	5.50	6.83	9.50	
Ropes Horse, Ropes Bros.	Salem	16.11	13.00	6.41	5.50	7.70	9.50	
Ralston Purina Co., St. Louis, Mo.								
Protena, D. B. Hodgkins Sons	Manchester	20.27	20.00	4.48	4.50	14.92	14.00	Cottonseed meal, brewers grains, hominy feed, alfalfa meal.
A. H. Wood & Co., Framingham, Mass.								
Dairy Blend, A. H. Wood & Co.	Framingham	23.38	20.00	5.38	4.00	9.80	12.00	Corn, oats, alfalfa meal, wheat bran, wheat middlings, gluten feed, cottonseed meal, linseed meal, beet pulp, salt.

MOLASSES FEEDS.

Definition. Molasses feeds are mixtures of molasses, low grade milling offal and high grade feeding stuffs.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
			%	%	%	%	%	%	
American Milling Co., Peoria, Ill.									
Sucrene,	N. Tufts & Sons	Charlestown	19.39	16.50	5.77	3.50	10.26	12.00	Cottonseed meal, gluten feed, molasses, oat clippings, ground and bolted grain screenings, salt.
Sucrene,	C. T. Wyman	Hubbardston	17.72	16.50	4.07	3.50	12.00	12.00	
Sucrene,	C. T. Wyman	Hubbardston	17.16	16.50	4.27	3.50	12.50	12.00	
Sucrene,	Milford Grain Co.	Milford	16.66	16.50	5.24	3.50	11.12	12.00	
Sucrene,	Berkshire Coal & Gr. Co.	N. Adams	17.37	16.50	4.98	3.50	10.62	12.00	
Sucrene,	Beaver Coal & Grain Co.	Norwood	19.05	16.50	6.14	3.50	11.54	12.00	
Sucrene,	Beaver Coal & Grain Co.	Norwood	15.38	16.50	3.94	3.50	11.58	12.00	
Clover Leaf Milling Co., Buffalo, N. Y.									
Peerless,	Sprague & Williams	S. Framingham	19.17	21.00	3.77	6.00	9.92	9.00	Cottonseed meal, wheat bran, distillers grains, gluten feed, oat clips, molasses, salt.
F. W. Dorr & Co., Newton, Mass.									
Harvard,	F. W. Dorr & Co.	Newton Centre	18.67	18.00	4.12	4.00	7.78	9.00	Cottonseed meal, gluten feed, oat clips, corn meal, linseed oil meal, wheat middlings, distillers grains, malt sprouts, molasses, salt.
Husted Milling Co., Buffalo, N. Y.									
Husted	C. H. Laflin	Brookfield	22.33	18.00	3.87	4.00	7.81	9.00	Cottonseed meal, gluten feed, oat clips, corn meal, linseed oil meal, wheat middlings, distillers grains, malt sprouts, molasses, salt.
Husted,	Brockelman Bros.	Clinton	21.77	18.00	3.95	4.00	7.32	9.00	
Husted,	Griffin Bros.	Fall River	21.06	18.00	4.09	4.00	8.62	9.00	
Husted,	Griffin Bros.	Fall River	21.02	18.00	3.81	4.00	8.70	9.00	
Husted,	H. L. Patrick	Hopedale	21.91	18.00	4.10	4.00	8.97	9.00	
Husted,	E. W. Brayman	Lee	20.26	18.00	3.68	4.00	9.01	9.00	
Husted,	G. Methe & Sons	Springfield	18.30	18.00	3.71	4.00	7.65	9.00	
International Sugar Feed Co., Minneapolis, Minn									
Dairy,	A. D. Potter	Orange	15.83	16.50	4.31	3.50	11.24	12.00	Cottonseed meal, molasses, cleaned grain screenings, oat clips, salt.
Dairy,	A. D. Potter	Orange	16.53	16.50	4.78	3.50	11.71	12.00	
Special	J. Burkhardt	Beverly	14.67	14.00	4.59	3.50	13.28	12.00	Cottonseed meal, molasses, ground cleaned grain screenings, ground clipped oat by-product salt.
Special,	Marlboro Grain Co.	Marlboro	14.65	14.00	6.01	3.50	14.52	12.00	
Chas. A. Krause Milling Co., Milwaukee, Wis.									
Badger,	W. P. Barney	Seekonk	18.66	16.00	2.65	2.00	9.39	15.00	Cottonseed meal, corn oil meal, malt sprouts, brewers grains, alfalfa meal, molasses, salt.
Northwest Mills Co., Winona, Minn.									
Sugarota,	J. Shea	Lawrence	16.33	16.50	4.57	3.50	14.01	14.00	Cottonseed meal, malt sprouts, grain screenings, molasses, salt.
Sugarota,	H. K. Webster Co.	Lawrence	17.27	16.50	4.11	3.50	12.29	14.00	

MOLASSES FEEDS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Quaker Oats Co., Chicago, Ill.								
Blue Ribbon, C. H. Laflin	Brookfield	24.54	25.00	4.45	4.00	9.77	9.00	Wheat bran, malt sprouts, cottonseed meal, hominy feed, molasses, oat clippings.
Blue Ribbon, G. F. Wetherbee Co.	Gardner	24.70	25.00	4.14	4.00	13.84	9.00	
Blue Ribbon, W. J. Meek	Fall River	23.68	25.00	3.80	4.00	11.49	9.00	
Blue Ribbon, W. J. Meek	Fall River	24.81	25.00	4.33	4.00	12.87	9.00	
Blue Ribbon, E. H. Cowee	Jefferson	25.67	25.00	4.93	4.00	10.21	9.00	
Blue Ribbon, F. Gauvin	Marlboro	24.31	25.00	4.25	4.00	10.14	9.00	
Daisy, G. F. Wetherbee Co.	Gardner	15.49	16.00	4.06	4.50	11.85	14.50	Cottonseed meal, malt sprouts, grain screenings meal, flax plant by-product, oat clippings, molasses.
Daisy, G. F. Wetherbee Co.	Gardner	17.07	16.00	4.57	4.50	17.07	14.50	
Daisy, Mackenzie & Winslow	Fall River	14.86	16.00	4.10	4.50	10.36	14.50	
Daisy, T. E. Borden	N. Westport	14.75	16.00	3.69	4.50	16.76	14.50	
Quaker Dairy, C. A. Pierce	Hinsdale	15.06	16.00	3.28	4.50	12.64	14.50	Cottonseed meal, malt sprouts, grain screenings meal, flax plant by-product, oat clippings, molasses.
Quaker Dairy, Bowen & Fuller	Leominster	17.57	16.00	3.89	4.50	17.82	14.50	
Quaker Dairy, F. A. Fales & Co.	Norwood	17.04	16.00	4.42	4.50	15.10	14.50	
Western Grain Products Co., Hammond, Ind.								
Hammond Dairy, A. E. Lawrence & Son	Ayer	17.52	16.50	3.19	3.50	10.31	11.00	Cottonseed meal, distillers grains, malt sprouts, corn, oats, barley, wheat screenings, molasses, salt.
Hammond Dairy, C. P. McClanathan	Barre Plains	17.24	16.50	4.80	3.50	10.67	11.00	
Hammond Dairy, E. E. Cole Co.	Billerica	17.68	16.50	3.57	3.50	10.01	11.00	
Hammond Dairy, E. E. Cole Co.	Billerica	17.21	16.50	3.63	3.50	12.28	11.00	
Hammond Dairy, J. B. Cover & Co.	Lowell	16.92	16.50	3.47	3.50	10.23	11.00	
Hammond Dairy, Marlboro Grain Co.	Marlboro	13.03	16.50	3.63	3.50	9.49	11.00	
Hammond Dairy, C. B. Sawin & Son	Southboro	15.96	16.50	3.46	3.50	9.46	11.00	
Hammond Dairy, G. Methe & Son	Springfield	17.40	16.50	5.07	3.50	10.63	11.00	

CALF MEALS.

Definition. Calf meal is a proprietary mixture intended as a feed for young calves.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
J. Bibby & Sons, Liverpool. England.								
Cream Equivalent, J. Loring & Co.	Watertown	17.10	14.00	14.11	14.00	5.44	7.00	Linseed, linseed cake, tapioca flour, sago flour, rice polish, starch, locust beans, salt.
Cream Equivalent, J. Loring & Co.	Watertown	17.35	14.00	14.83	14.00	5.50	7.00	

CALF MEALS (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Blatchfords Calf Meal Factory, Waukegan, Ill.								
Blatchfords, ... C. P. McClanathan	Barre Plains.....	26.97	24.00	4.69	5.00	6.32	6.00	Locust bean meal, wheat flour, flaxseed, cocoanut meal, gd. beans and peas, linseed oil meal, cocoa shells, recleaned cottonseed meal, fenugreek, salt.
Blatchfords, ... N. Attleboro Grain Co.	N. Attleboro...	25.09	24.00	6.18	5.00	6.45	6.00	
Northwest Mills Co., Winona, Minn.								
Sugarota, ... J. B. Garland & Son...	Worcester.......	25.39	25.00	5.22	6.00	8.22	6.00	Pulverized wheat, pulverized malt, linseed meal, cottonseed meal.
Quaker Oats Co., Chicago, Ill.								
Schumachers, ... P. W. Eaton & Co....	Williamstown...	16.55	19.00	6.35	8.00	1.62	3.00	Wheat meal, oat meal, flax seed meal, dried casein.

MISCELLANEOUS PROTEIN FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
Atwood-Stone Co., Minneapolis, Minn.								
Cracker Jack Feed, . Jaquith & Co.	Woburn........	15.50	15.00	4.80	6.00	12.93	20.00	Recleaned wheat and flax screenings.
J. Bibby & Sons, Liverpool, England.								
Pig Meal, ... J. Loring & Co.	Watertown.....	15.20	12.00	6.13	4.00	8.09	10.00	Corn meal, wheat middlings, rice polish, sago meal, tapioca meal, peanut cake, palm kernel meal, locust beans, molasses, salt.
Corn Products Refining Co., New York, N. Y.								
Argo Corn Oil Meal Plummer & Jennings Gr. Co	New Bedford...	19.66	19.00	7.11	7.50	9.05	15.00	
Postum Cereal Co., Battle Creek, Mich.								
CXX Feed .... I. J. Rowell	Pepperell......	18.13	15.00	2.69	2.00	15.91	24.00	Wheat, wheat bran, molasses.
Quaker Oats Co., Chicago, Ill.								
Puffed wheat, ... J. Burkhardt	Beverly....	15.88	15.00	2.70	2.50	2.80	1.50	
Puffed wheat, ... Rollstone Grain Co.	Fitchburg ...	15.85	15.00	2.39	2.50	2.25	1.50	

II. STARCHY (CARBOHYDRATE) FEEDS.

CORN MEAL.

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein.		Fat.		Fiber.	
			Found.	Guar.	Found.	Guar.	Found.	Guar.
			%	%	%	%	%	%
Ground by Retailer.								
	Dresser Hull Co.	Lee	9.02	—	3.56	—	1.54	—
	Eastern Grain Co.	Bridgewater	8.67	—	2.56	—	2.33	—
	J. O. Ellison & Co.	Haverhill	8.41	—	3.67	—	2.59	—
	F. A. Fales & Co.	Norwood	8.67	—	3.46	—	2.09	—
	W. K. Gilmore & Sons	Wrentham	8.82	—	3.86	—	1.78	—
	Malden Grain Co.	Malden	9.37	—	3.58	—	1.48	—
	McKenzie & Winslow	Fall River	9.13	—	3.83	—	2.85	—
	E. C. Packard	Brockton	9.02	—	3.82	—	1.71	—
	E. C. Packard	Brockton	9.13	—	3.96	—	1.45	—
Bolted Meal	E. C. Packard	Brockton	9.18	—	3.63	—	0.99	—
Bolted Meal	E. C. Packard	Brockton	9.23	—	4.25	—	1.26	—
	Pittsfield Grain Co.	Pittsfield	9.19	—	3.19	—	2.98	—
	C. S. Tarbox	E. Braintree	8.95	—	4.22	—	1.70	—
Amendt Milling Co., Monroe, Mich.								
Amco Feed Meal	Worcester Hay & Grain Co	Worcester	9.89	—	5.35	—	2.51	—
Amco Feed Meal	Worcester Hay & Grain Co	Worcester	8.23	—	3.61	—	1.83	—
E. W. Bailey Co., Montpelier, Vt.								
	J. E. Merrick & Co.	Amherst	8.73	—	3.46	—	1 87	—
E. A. Cowee, Worcester, Mass.								
	C. T. Wyman	Hubbardston	9.37	—	3.39	—	2.24	—
Mansfield Milling Co., Mansfield, Mass.								
	A. Milot & Sons	Taunton	9.44	—	3.88	—	1.88	—
Meech & Stoddard, Middletown, Conn.								
	Jacobson Bros.	N. Dartmouth	9.52	—	4.77	—	3 48	—
Narragansett Milling Co., E. Providence, R. I.								
	N. Attleboro Grain Co.	N. Attleboro	8.95	—	3.58	—	2.28	—
	Average		9.05	—	3.73	—	2.04	—

GROUND OATS.

Ground by Retailer.							
E. A. Cole	Housatonic	12.17	—	4.44	—	8.93	—
Hingham Grain Mills	Hingham	11.93	—	5.27	—	8.11	—
Jacobson Bros.	N. Dartmouth	11.44	—	4.72	—	8.88	—
McKenzie & Winslow	Fall River	11.84	—	4.35	—	8.78	—
Morse Bros.	Southbridge	13.18	—	5.47	—	8.32	—
E. C. Packard	Brockton	11.58	—	4.47	—	9.65	—
E. C. Packard	Brockton	12.43	—	4.57	—	10.11	—
Dexter Root Co.	Springfield	13.49	—	4.29	—	10.41	—
M. G. Williams	Raynham	11.14	—	3.77	—	9.05	—
Mansfield Milling Co., Mansfield, Mass.							
A. Milot & Son	Taunton	12.77	—	4.17	—	10.08	—
Narragansett Milling Co., E. Providence, R. I.							
N. Attleboro Grain Co.	N. Attleboro	11.76	—	4.93	—	8.58	—

RYE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
E. C. Packard, Brockton, Mass.							
E. C. Packard	Brockton	9.72	—	1.63	—	1.76	—
Cutler Co., N. Wilbraham, Mass.							
F. Gauvin	Marlboro	11.38	—	1.67	—	1.93	—

HOMINY MEAL.

Definition. Hominy meal, feed or chop is a by-product in the manufacture of hominy grits from corn, and consists of the hull and corn germ together with a considerable portion of the corn starch.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
American Hominy Co., Indianapolis, Ind.							
Homco, G. W. King	Charlton	12.08	9.50	6.55	7.00	5.08	7.00
Homco, B. W. Brown	Concord	10.94	9.50	6.67	7.00	4.46	7.00
Homco, A. M. Haggart	Franklin	10.59	9.50	8.12	7.00	3.91	7.00
Homco, A. D. Potter	Orange	12.52	9.50	6.13	7.00	5.15	7.00
Homco, F. Diehl & Son	Wellesley	10.59	9.50	7.22	7.00	4.70	7.00
M. F. Barringer, Philadelphia, Pa.							
Keystone, McKenzie & Winslow	Fall River	11.03	9.00	8.50	6.00	2.22	10.00
Keystone, McKenzie & Winslow	Fall River	10.93	9.00	7.53	6.00	1.99	10.00
Keystone, J. Cushing & Co.	Fitchburg	10.86	9.00	8.42	6.00	1.85	10.00
Keystone, T. E. Borden	N. Westport	9.11	9.00	5.04	6.00	1.14	10.00
Keystone, J. Cushing & Co.	Stoughton	10.51	9.00	7.94	6.00	1.96	10.00
Beatrice Corn Mills, Lincoln, Neb.							
Mansfield Milling Co.	Mansfield	11.14	10.00	8.48	8.00	5.23	10.00
Buffalo Cereal Co., Buffalo, N. Y.							
W. E. Bryant & Co.	Brockton	10.51	10.00	7.51	7.00	3.29	4.00
Wallace Grain Co.	Clinton	11.25	10.00	8.15	7.00	4.55	4.00
F. F. Woodward Co.	Fitchburg	9.63	10.00	7.85	7.00	3.95	4.00
Potter Bros. Co.	N. Adams	10.63	10.00	6.73	7.00	3.19	4.00
Morse Bros.	Southbridge	10.16	10.00	7.41	7.00	3.98	4.00
Chas. M. Cox Co., Boston, Mass.							
Wirthmore, Eastern Grain Co.	Bridgewater	11.99	9.50	7.53	7.50	4.58	5.00
Wirthmore, C. W. Upham	Foxboro	10.44	9.50	7.40	7.50	5.03	5.00
Wirthmore, J. F. Kirk	New Bedford	10.18	9.50	7.75	7.50	3.23	5.00
Wirthmore, Whitney Coal & Grain Co.	N. Adams	11.17	9.50	7.35	7.50	4.48	5.00
Wirthmore, F. A. Fales & Co.	Norwood	11.38	9.50	8.47	7.50	3.86	5.00
Wirthmore, H. C. Puffer Co.	Springfield	10.68	9.50	7.80	7.50	3.61	5.00
Wirthmore, F. Diehl & Son	Wellesley	10.86	9.50	8.03	7.50	3.38	5.00
W. H. Haskell & Co., Toledo, Ohio.							
Stanley Wood Grain Co.	Taunton	9.54	9.50	7.25	7.50	3.15	5.00
Husted Milling Co., Buffalo, N. Y.							
Yellow, J. Burkhardt	Beverly	10.24	9.00	6.75	6.00	3.84	8.00
Yellow, C. A. Pierce	Hinsdale	10.59	9.00	7.10	6.00	3.40	8.00
Yellow, H. J. Williams	Lowell	9.81	9.00	6.34	6.00	3.43	8.00
J. B. A. Kern & Sons, Milwaukee, Wis.							
Eagle, A. T. Knight Co.	Hudson	10.68	9.25	7.38	7.00	3.78	3.15
Eagle, Blood Bros.	Medford	9.98	9.25	6.93	7.00	3.56	3.15
Chas. A. Krause Co., Milwaukee, Wis.							
Badger, W. J. Meek	Fall River	11.64	10.00	6.86	6.00	4.29	5.00
Badger, J. B. Garland & Son	Worcester	11.47	10.00	7.39	6.00	4.62	5.00

HOMINY MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
H. E. McEachron Co., Wausau, Wis.							
J. Shea	Lawrence	10.51	11.25	6.40	8.50	3.21	4.00
Potter Grain Co.	Shelburne Falls	11.52	11.25	7.53	8.50	4.09	4.00
Miner-Hillard Milling Co., Wilkes-Barre, Pa.							
Evans & Bowker	Baldwinsville	10.77	10.00	5.02	5.00	3.99	5.00
C. P. McClanathan	Barre Plains	10.77	10.00	5.77	5.00	3.53	5.00
Bowen & Fuller	Leominster	10.86	10.00	4.92	5.00	3.46	5.00
Conant & Co.	Littleton	10.68	10.00	6.29	5.00	3.78	6.00
D. B. Hodgkins Sons	Manchester	10.07	10.00	5.55	5.00	3.53	5.00
Loham Bros.	Marblehead	10.68	10.00	5.79	5.00	3.81	5.00
McKenzie & Winslow	New Bedford	11.73	10.00	5.31	5.00	4.70	5.00
Taunton Grain Co.	Taunton	10.97	10.00	5.32	5.00	3.78	5.00
Patent Cereal Co., Geneva, N. Y.							
W. N. Potter & Co.	Charlemont	10.77	10.00	7.57	7.00	4.58	5.00
Bond Grain Co.	Charlton	11.03	10.00	7.91	7.00	4.18	5.00
F. Gauvin	Marlboro	10.86	10.00	8.44	7.00	4.20	5.00
C. P. Washburn	Middleboro	10.43	10.00	7.61	7.00	4.08	5.00
S. L. Davenport & Son	N. Grafton	10.86	10.00	6.73	7.00	5.98	5.00
W. N. Potter Grain Co.	Princeton	10.16	10.00	7.22	7.00	3.50	5.00
Warren Grain Co.	Warren	10.33	10.00	7.87	7.00	3.48	5.00
Quaker Oats Co., Chicago, Ill.							
Yellow, J. Burkhardt	Beverly	10.07	9.00	6.33	4.00	3.22	4.00
J. E. Soper Co., Boston, Mass.							
Blue Ribbon, Lummus & Parker	Danversport	10.86	10.00	7.99	7.00	4.35	5.00
Blue Ribbon, Lummus & Parker	Danversport	11.73	10.00	9.57	7.00	4.83	5.00
Blue Ribbon, W H. Garland	Gloucester	10.79	10.00	7.80	7.00	3.98	5.00
Blue Ribbon, J. Franks	New Bedford	11.21	10.00	5.83	7.00	3.29	5.00
Blue Ribbon, A. N. Whittemore	Worcester	11.03	10.00	8.77	7.00	4.16	5.00
Sparr Cereal Co., Marshfield, Wis.							
E. C. Packard	Brockton	10.94	8.00	7.27	8.00	4.04	7.00
Standard Cereal Co., Chillicothe, Ohio.							
Logan, B. W. Brown	Concord	10.68	9.00	7.62	7.00	4.10	6.00
Logan, Haverhill Milling Co.	Haverhill	10.68	9.00	7.41	7.00	4.29	6.00
Logan, T. E. Borden	N. Westport	11.12	9.00	8.04	7.00	4.03	6.00
Logan, Weld & Beck	Southbridge	10.77	9.00	7.42	7.00	4.13	6.00
Standco, W. Livingston	Lowell	9.98	10.00	4.87	7.00	1.35	4.00
Standco, Bryant & Soule	Middleboro	11.29	10.00	9.65	7.00	5.09	4.00
Standco, E. C. Frost	Shelburne Falls	10.68	10.00	8.06	7.00	2.38	4.00
Suffern, Hunt & Co., Decatur, Ill.							
Acme, G. W. King	Charlton	11.21	9.30	8.75	7.10	4.48	10.00
Acme, H. J. Williams	Lowell	11.12	9.30	8.67	7.10	4.58	10.00
Acme, Beaver Coal & Grain Co.	Norwood	11.38	9.30	9.49	7.10	4.96	10.00
Acme, Cutler Co.	W. Brookfield	11.21	9.30	9.18	7.10	4.45	10.00
U. S. Frumentum Co., Detroit, Mich.							
Frumentum, A. M. Haggart	Franklin	9.46	9.50	5.73	7.30	3.42	7.00
Average		10.78	—	7.29	—	3.85	—

PROVENDER.

Definition. Provender is a mixture of whole corn and whole oats ground together.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Ground by Retailer.							
M. E. Ballou & Son	Becket	9.85	—	4.31	—	3.25	—
J. M. Buck	Stockbridge	10.51	—	3.92	—	3.22	—
E. A. Cowee Est.	Worcester	10.77	—	3.88	—	5.08	—
J. W. Doon & Son	Natick	10.33	—	3.37	—	3.73	—
Dresser Hull Co.	Lee	9.19	—	3.72	—	2.90	—
F. A. Fales & Co.	Norwood	10.24	—	2.34	—	4.91	—
W. K. Gilmore & Sons	Wrentham	10.97	—	4.98	—	8.10	—
E. C. Packard	Brockton	10.01	—	4.68	—	5.33	—
E. C. Packard	Brockton	10.59	—	4.65	—	5.42	—
C. O. Parmenter & Co.	S. Sudbury	10.24	—	4.17	—	5.55	—
H. C. Puffer Co.	Springfield	10.07	—	3.89	—	4.24	—
G. C. Turner	Chester	10.33	—	4.59	—	4.25	—
M. G. Williams	Raynham	9.65	—	4.46	—	4.78	—
E. A. Cowee Est., Worcester, Mass.							
No. 1, I. J. Rowell	Pepperell	10.29	9.00	3.70	3.00	5.68	5.50
I. J. Rowell	Pepperell	10.42	9.00	3.93	3.00	6.10	5.50
J. Cushing & Co., Fitchburg, Mass.							
S. B. Green & Co.	Watertown	10.51	—	3.78	—	4.95	—
Globe Elevator Co., Buffalo, N. Y.							
1-2 and 1-2, A. M. Haggart	Franklin	9.98	—	3.90	—	5.71	—
Husted Milling Co., Buffalo, N. Y.							
Steam Cooked, J. Burkhardt	Beverly	10.58	9.00	3.58	4.00	4.65	6.00
Steam Cooked, F. H. Crane & Sons	Quincy Adams	10.68	9.00	4.84	4.00	6.10	6.00
Steam Cooked, F. H. Crane & Sons	Quincy Adams	10.44	9.00	4.38	4.00	3.99	6.00
1-2 and 1-2, H. L. Patrick	Hopedale	10.20	9.00	3.80	4.00	5.30	6.00
1-2 and 1-2, E. W. Brayman	Lee	10.42	9.00	4.54	4.00	5.93	6.00
1-2 and 1-2, W. D. French	Sheffield	11.03	9.00	4.78	4.00	5.87	6.00
Imperial Grain & Milling Co., Toledo, Ohio.							
Imperial, H. K. Webster Co.	Lawrence	9.19	9.50	4.08	4.00	2.83	4.00
Mansfield Milling Co., Mansfield, Mass.							
A. Milot & Sons	Taunton	10.49	—	3.75	—	4.30	—
Narragansett Milling Co., E. Providence, R. I.							
H. E. Thompson	Plainville	9.30	9.50	3.64	3.50	8.00	—
Pratt & Co., Buffalo, N. Y.							
Harvester, C. G. Burnham	Holyoke	10.42	9.00	4.64	4.00	5.86	6.00
Harvester, C. G. Burnham	Holyoke	9.63	9.00	3.87	4.00	3.55	6.00
H. C. Puffer Co. Springfield, Mass.							
G. C. Turner	Chester	10.47	—	3.62	—	3.61	—
Stratton & Co. Concord, N. H.							
I. J. Rowell	Pepperell	11.12	—	4.00	—	5.05	—

DRIED BEET PULP.

Definition. Dried beet pulp is the dried sugar beet residue obtained in the manufacture of beet sugar.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
Larrowe Milling Co., Detroit, Mich.							
J. E. Merrick & Co.	Amherst	8.67	8.00	0.46	0.50	19.62	20.00
McKenzie & Winslow	Fall River	9.37	8.00	0.77	0.50	17.87	20.00
E. A. Cowee Est.	Jefferson	8.49	8.00	0.58	0.50	16.62	20.00
H. K. Webster & Co.	Lawrence	9.31	8.00	0.53	0.50	17.70	20.00
McKenzie & Winslow	New Bedford	8.14	8.00	0.75	0.50	19.63	20.00
Potter Bros. Co.	N. Adams	9.37	8.00	0.62	0.60	17.93	20.00
Glen Mills Cereal Co.	Rowley	9.54	8.00	0.81	0.50	17.26	20.00
J. Paull & Co.	Taunton	8.99	8.00	0.48	0.50	17.38	20.00
C. R. Conant	Whitman	8.76	8.00	0.79	0.50	18.66	20.00
Charles Pope, Chicago, Ill.							
A. Dodge & Co.	Gloucester	8.49	8.00	0.55	0.60	18.43	20.00

STOCK AND HORSE FEEDS (Containing less than 12% protein).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Wm. C. Brett, N. Abington, Mass.								
All Right, W. C. Brett	N. Abington	10.05	9.00	7.30	4.00	8.90	7.50	Hominy meal, oat feed.
Buffalo Cereal Co., Buffalo, N. Y.								
Chop, J. Burkhardt	Beverly	9.37	7.00	3.37	3.00	10.73	9.00	Corn, hominy feed, oat bran, oat hulls.
Horse, Griffin Bros.	Fall River	10.59	10.00	3.80	4.00	9.27	8.00	Oats, corn, barley, gluten feed, wheat middlings, oat hulls, oat bran, oat middlings.
Horse, F. H. Crane & Sons	Quincy Adams	11.64	10.00	4.36	4.00	7.80	8.00	
Iroquois, Horvitz Grain Co.	New Bedford	9.19	7.00	4.67	3.00	10.11	9.00	Corn, hominy feed, oat bran, oat hulls.
Stock, A. M. Butler	Avon	8.76	9.00	4.98	4.00	10.16	9.00	Corn, barley, cottonseed meal, Red Dog flour, oats, oat hulls, middlings and shorts, salt.
Stock, J. H. Nye	Brockton	9.83	9.00	5.02	4.00	10.43	9.00	
Stock, Griffin Bros.	Fall River	9.30	9.00	5.35	4.00	8.98	9.00	
Stock, H. L. Patrick	Hopedale	9.11	9.00	5.01	4.00	10.10	9.00	
Stock, H. L. Patrick	Hopedale	8.76	9.00	4.03	4.00	8.34	9.00	
Stock, A. Culver Co.	Rockland	9.54	9.00	5.14	4.00	9.99	9.00	
Chesbro Milling Co., Salamanca, N. Y.								
Chesbro, J. B. Bridges & Co.	S. Deerfield	10.07	9.00	4.23	3.25	7.57	9.00	Corn, barley, cottonseed meal, red dog flour, oat (shorts, middlings, hulls) salt.
Chas. M. Cox Co., Boston, Mass.								
Charlestock, Scott Grain Co.	Amesbury	7.71	6.00	3.34	3.00	10.46	16.00	Oat feed, cracked corn, hominy feed.
Charlestock, B. W. Brown	Concord	7.44	6.00	3.55	3.00	14.17	16.00	
Wirthmore, Scott Grain Co.	Amesbury	9.50	9.00	6.55	4.00	9.40	7.00	Hominy feed, oat feed.
Wirthmore, Knight Grain Co.	Newburyport	10.86	9.00	6.70	4.00	8.00	7.00	
Wirthmore, Weld & Beck	Southbridge	10.24	9.00	7.64	4.00	7.38	7.00	
F. W. Dorr & Co., Newton Centre, Mass.								
Matchless, F. W. Dorr & Co.	Newton	9.63	9.00	5.31	4.00	7.56	7.00	Hominy meal, corn meal, oat feed.
Matchless, F. W. Dorr & Co.	Newton	10.07	9.00	7.03	4.00	7.75	7.00	
Empire Mills, Olean, N. Y.								
Empire, Guay Bros.	New Bedford	8.93	7.50	4.45	3.00	7.10	9.00	Corn, hominy feed, oat hulls.

STOCK AND HORSE FEEDS—Containing less than 12% protein (Continued).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
			%	%	%	%	%	%	
J. B. Garland & Son, Worcester, Mass.									
Red Tag A,	Bond Grain Co.	Charlton	11.60	7.00	5.45	3.00	9.60	14.00	Corn, wheat middlings, oat feed, barley, grain screenings.
Red Tag A,	Bond Grain Co.	Charlton	9.46	7.00	4.70	3.00	14.90	14.00	
Red Tag A,	J. B. Garland & Son	Worcester	8.76	7.00	4.45	3.00	15.91	14.00	
Red Tag B,	J. B. Garland & Son	Worcester	10.07	7.00	4.36	3.00	12.41	16.00	Corn, wheat middlings, oat feed, grain screenings.
Red Tag B,	J. B. Garland & Son	Worcester	9.43	7.00	3.87	3.00	11.93	16.00	
Globe Elevator Co., Buffalo, N. Y.									
No. 1 Chop,	A. M. Haggart	Franklin	8.32	7.00	2.87	3.00	6.56	9.00	Corn, oats, oat hulls, flour middlings, salt.
D. H. Grandin Milling Co., Jamestown, N. Y.									
Grandins,	M. Callahan	Holyoke	7.79	8.50	3.00	3.50	8.72	9.00	Oats, corn, barley, barley middlings, hominy feed, oat hulls, salt.
Grandins,	J. Shea	Lawrence	9.02	8.50	2.09	3.50	6.53	9.00	
Grandins,	H. K. Webster Co.	Lawrence	8.32	8.50	6.70	3.50	9.10	9.00	
Grandins,	Mansfield Milling Co.	Mansfield	9.39	8.50	6.55	3.50	10.73	9.00	
Grandins,	J. F. Kirk	New Bedford	9.56	8.50	6.13	3.50	10.83	9.00	
Grandins,	A. N. Whittemore & Co.	Worcester	10.07	8.50	7.32	3.50	9.26	9.00	
W. H. Haskell & Co., Toledo, Ohio.									
Haskells,	T. H. Emerson	E. Weymouth	11.41	8.00	7.97	4.00	6.00	8.00	Corn, oats, hominy feed, oat hulls, oat shorts, salt.
Haskells,	Hingham Grain Mill	Hingham	9.11	8.00	5.69	4.00	6.27	8.00	
Haskells,	Bosworth & Son	Leominster	10.24	8.00	8.03	4.00	5.68	8.00	
Haskells,	Mackenzie & Winslow	New Bedford	8.53	8.00	5.92	4.00	7.20	8.00	
Haskells,	Taunton Grain Co.	Taunton	10.44	8.00	7.78	4.00	5.53	8.00	
Wm. S. Hills Co., Boston, Mass.									
Purity	Rollstone Grain Co.	Fitchburg	9.77	8.00	5.10	3.25	11.12	7.00	Hominy meal, oat feed, wheat middlings, barley, salt.
Purity,	C. G. Burnham	Holyoke	11.21	8.00	6.02	3.25	11.52	7.00	
Purity,	H. J. Williams	Lowell	10.07	8.00	5.67	3.25	11.21	7.00	
Purity,	P. Foisy	New Bedford	9.69	8.00	5.00	3.25	8.00	7.00	
Purity,	L. H. Kirk	Wakefield	10.07	8.00	6.89	3.25	9.93	7.00	
H-O Co., Buffalo, N. Y.									
Algrane Horse,	J. O. Ellison & Co.	Haverhill	11.56	11.00	3.67	4.00	11.30	9.00	Oats, oat (hulls & shorts), gluten feed, wheat middlings, corn, hominy feed, salt.
Algrane Horse,	Lenox Coal Co.	Lenoxdale	11.73	11.00	4.19	4.00	12.25	9.00	
Algrane Horse,	Beaver Coal & Grain Co.	Norwood	11.89	11.00	4.17	4.00	10.33	9.00	

STOCK AND HORSE FEEDS—Containing less than 12% protein (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
H-O Co., Buffalo, N. Y.								
N. E. Stock, ...A. T. Butler............	Adams.........	9.81	9.00	4.52	4.00	9.00	9.00	Corn, oats, oat (hulls & shorts), hominy feed, wheat middlings, salt.
N. E. Stock, ...H. K. Webster Co........	Lawrence.....	10.33	9.00	4.44	4.00	9.77	9.00	
N. E. Stock, ...Beaver Coal & Grain Co..	Norwood.....	10.51	9.00	5.01	4.00	9.47	9.00	
N. E. Stock, ...Beaver Coal & Grain Co.	Norwood....	9.92	9.00	2.60	4.00	8.93	9.00	
Husted Milling Co., Buffalo, N. Y.								
Mayflower, ...B. W. Brown............	Concord........	9.81	7.50	5.18	3.50	7.43	9.00	Corn meal, oats, hominy feed, oat hulls, salt.
Mayflower, ...Prentiss, Brooks & Co....	Holyoke........	9.28	7.50	3.66	3.50	5.69	9.00	
Mayflower, ...Prentiss, Brooks & Co....	Westfield....	9.11	7.50	3.54	3.50	5.37	9.00	
Monarch, ...WorcesterHay & Gr. Co...	West Brookfield.	10.16	7.50	4.82	3.50	7.02	9.00	Corn meal, oats, hominy feed, salt.
Zenith, ...Brockelman Bros.........	Clinton......	10.07	10.00	3.93	4.00	5.17	9.00	Corn meal, barley, wheat middlings, oat hulls salt.
Marshall-Hackel Co., Boston, Mass.								
Uniform, ...A. N. Whittemore & Co...	Worcester.......	7.97	8.00	4.31	3.00	6.41	9.00	Corn, hominy feed, oat hulls.
Uniform, ...A. N. Whittemore & Co...	Worcester......	9.02	8.00	4.05	3.00	6.23	9.00	
Meech & Stoddard, Middletown, Conn.								
Korn-Oato, ...Thorne Bros............	Millis.........	6.66	7.00	2.67	3.00	12.01	16.00	Corn meal, oat hulls.
M & S. ....Weld & Beck............	Southbridge...	10.16	9.00	5.48	3.00	6.93	12.00	Hominy meal, oat hulls.
Mystic Milling & Feed Co., Rochester, N. Y.								
Mystic, ...E. J. Adams............	Gt. Barrington	11.56	9.00	3.87	4.00	6.72	12.00	Corn meal, corn bran, oats, oat (hulls & shorts) wheat middlings, cottonseed meal.
Mystic, ...W. P. Griffin............	Pittsfield.......	10.42	9.00	3.35	4.00	2.55	12.00	
W. N. Potter's Sons, Springfield, Mass.								
Special Provender,..W. S. Harrington........	Adams.........	9.63	8.75	3.59	3.50	7.53	8.00	Corn, oats, oat hulls.
Special Provender,..G. W. King............	Charlton.......	9.63	8.75	3.76	3.50	6.18	8.00	
Special Provender,..S. L. Davenport & Son...	N. Grafton.....	9.37	8.75	3.18	3.50	6.23	8.00	
Quaker Oats Co., Chicago, Ill.								
Boss, ...G. F. Wetherbee Co.....	Gardner......	8.67	8.00	3.05	3.00	9.83	12.00	Corn, oat (middlings, hulls, shorts), flax plant by-product, salt.
Schumachers, ...McKenzie & Winslow....	Fall River......	10.83	10.00	3.70	3.00	9.26	10.00	Corn, barley, wheat middlings, wheat flour, cottonseed meal, oat (middlings, hulls, shorts), salt.
Schumachers, ...C. A. Pierce............	Hinsdale......	11.64	10.00	4.48	3.00	10.99	10.00	
Schumachers, ...M. G. Williams..........	Raynham.....	11.03	10.00	3.59	3.00	9.99	10.00	

STOCK AND HORSE FEEDS—Containing less than 12% protein (Continued)

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
			%	%	%	%	%	%	
Quaker Oats Co., Chicago, Ill.									
Schumachers Spec.	J. Burkhardt	Beverly	9.46	9.25	3.47	3.25	8.62	3.00	Corn, oats, oat (middlings, hulls, shorts), salt.
Schumachers Spec.	Wallace Grain Co.	Clinton	10.07	9.25	3.41	3.25	5.60	8.00	
Schumachers Spec.	Wallace Grain Co.	Clinton	9.59	9.25	3.65	3.25	7.22	8.00	
Schumachers Spec.	M. H. Rolfe Est.	Newburyport	9.77	9.25	3.51	3.25	7.33	3.00	
Sterling,	G. F. Wetherbee Co.	Gardner	11.03	10.00	3.64	3.25	10.41	10.00	Corn, wheat middlings, wheat flour, barley, cottonseed meal, oat (middlings, hulls, shorts), salt.
Victor,	C. A. Pierce	Hinsdale	9.46	8.00	5.01	3.00	9.93	12.00	Corn, oat (middlings, hulls, shorts), flax plant by-product, salt.
Victor,	Conant & Co.	Littleton	8.23	8.00	3.31	3.00	8.75	12.00	
Victor,	Ropes Bros.	Salem	3.41	8.00	3.07	3.00	8.75	12.00	
Victor,	W. K. Gilmore & Sons	Wrentham	8.72	8.00	3.23	3.00	8.17	12.00	
White Diamond,	Plummer & Jennings Gr. Co.	New Bedford	9.46	8.00	4.63	3.25	8.55	9.00	Corn, oat (middlings, hulls, shorts), salt.
White Diamond	W. F. Little	Worcester	9.89	8.00	5.15	3.25	8.19	9.00	
David Stott, Detroit, Mich.									
Winner,	G. F. Wetherbee Co.	Gardner	9.46	8.00	5.72	4.00	9.32	10.00	Corn, oats, screenings, oat hulls, salt.
Stratton & Co., Concord, N. H.									
Stratton's,	F. G. Morey & Co.	Billerica	10.42	10.00	6.33	3.25	10.13	9.00	Corn, barley, oat (shorts, middlings, hulls) salt.
H. K. Webster Co., Lawrence, Mass.									
	H. K. Webster Co.	Lawrence	9.11	8.00	4.63	4.00	10.68	9.00	Corn, hominy feed, oat (hulls, bran), gluten feed.
	H. K. Webster Co.	Lawrence	9.63	8.00	3.42	4.00	7.85	9.00	
F. F. Woodward Co., Fitchburg.									
Very Best,	F. F. Woodward Co.	Fitchburg	10.51	10.00	7.65	4.00	7.06	7.00	Oats, barley, corn, hominy feed, oat feed.
Very Best	H. G. Hill Co.	Williamsburg	10.20	10.00	6.50	4.00	7.70	7.00	

STOCK AND HORSE FEEDS, (12-15% Protein).

Manufacturer or Jobber, Brand and Retailer.		Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
Amendt Milling Co., Monroe, Mich.									
Amco Chop,	Rollstone Grain Co.	Fitchburg	14.23	7.87	3.19	3.92	7.22	10.95	Corn feed meal, corn screenings, wheat screenings, oat screenings, oat clippings, malt sprouts.
Amco Chop,	C. L. Marsh	Webster	11.99	7.87	3.51	3.92	6.80	10.95	

STOCK AND HORSE FEEDS—12—15% protein (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Buffalo Cereal Co., Buffalo, N. Y.								
Horse,............Griffin Bros.............	Fall River......	12.11	10.00	4.40	4.00	9.45	8.00	Oats, corn, barley, gluten feed, wheat middlings, oat (hulls, bran, middlings).
Green River Grain Co., Greenfield, Mass.								
O. K. Horse,.......W. N. Potter's Sons......	Springfield......	13.36	12.00	5.75	4.25	6.22	8.00	Hominy feed, oats, wheat bran, linseed oil meal.
O. K. Horse,.......W. N. Potter's Sons......	Springfield......	14.01	12.00	6.18	4.25	7.68	8.00	
H-O. Co., Buffalo, N. Y.								
Algrane Horse,.....J. O. Ellison & Co........	Haverhill.......	13.14	11.00	4.80	4.00	10.68	9.00	Oats, oat (hulls, shorts), gluten feed, wheat middlings, corn, hominy feed, salt.
Algrane Horse .....Beaver Coal & Grain Co..	Norwood........	12.43	11.00	4.42	4.00	11.26	9.00	
D. B. Hodgkins Sons, Manchester, Mass.								
Hodgkins, Horse,...D. B. Hodgkins Sons.....	Manchester.....	13.75	11.00	6.20	4.00	7.60	10.00	Hominy meal, wheat middlings, wheat bran, alfalfa.
Lexington Grain Co., Lexington, Mass.								
Alfalfa Union Horse,Lexington Grain Co.....	Lexington.......	13.49	9.00	4.10	3.00	7.78	13.00	Alfalfa meal, hominy meal, wheat mixed feed and middlings, grain cleanings, corn, oats, oat screenings, salt.
Alfalfa Union Horse,Lexington Grain Co......	Lexington.......	14.45	9.00	5.63	3.00	8.23	13.00	
Good Value Horse, .Lexington Grain Co......	Lexington.......	12.17	10.00	4.43	3.00	5.58	10.00	Oats, hominy meal, wheat middlings, gluten feed, grain cleanings, salt.
Quaker Oats Co., Chicago, Ill.								
Schumachers,......V. E. Moore............	Springfield......	12.08	10.00	4.67	3.00	10.75	10.00	Corn, wheat middlings and flour, barley, cottonseed meal, oat (middlings, hulls, shorts), salt.
Ralston Purina Co., St. Louis, Mo.								
Purina,...........A. Dodge & Son.........	Beverly.........	14.54	12.00	4.07	4.00	11.65	9.80	Corn, oats, brewers grains, hominy feed, alfalfa meal.
Purina,...........I. Morton & Co..........	Plymouth.......	14.10	12.00	4.72	4.00	10.64	9.80	
F. F. Woodward Co., Fitchburg, Mass.								
Very best,.........H. G. Hill Co...........	Williamsburg....	12.43	10.00	7.14	4.00	6.32	7.00	Oats, barley, corn, hominy feed, oat feed.

MOLASSES FEEDS (Less than 15% Protein).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
Clover Leaf Milling Co., Buffalo, N. Y.								
Clover Leaf Horse,.Sprague & Williams......	S. Framingham..	10.94	12.00	3.22	3.00	7.15	12.00	Corn, oats, alfalfa meal, bran, molasses, salt,
Husted Milling Co., Buffalo, N. Y.								
Alfalfa Horse,......Bedford Coal & Grain Co..	Bedford.......	9.69	10.00	2.99	2.00	9.83	15.00	Alfalfa meal, cracked corn, barley, linseed meal, whole oats, wheat bran, molasses, salt.

MOLASSES FEEDS—Less than 15% protein (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Husted Milling Co., Buffalo, N. Y.								
Germaline, ...Ropes Bros.	Danvers	9.59	9.00	3.52	3.00	2.55	4.00	Corn meal, molasses.
Oatmolene Horse,..C. F Pease	Chester	10.59	9.00	4.06	3.00	7.54	7.00	Ground oats, cracked corn, wheat bran, molasses.
Oatmolene Horse..H. L. Patrick	Hopedale	9.87	9.00	3.85	3.00	6.11	7.00	
Oatmolene Horse,..W. G. Horton	Ipswich	12.30	9.00	4.51	3.00	6.45	7.00	
Oatmolene Horse,..G. M. Foster	Lowell	9.05	9.00	3.18	3.00	6.35	7.00	
Oatmolene Horse,..Butman Cressey Co.	Lynn	10.79	9.00	3.78	3.00	8.13	7.00	
Oatmolene Horse,..Worcester Hay & Gr. Co.	W. Brookfield	10.50	9.00	3.56	3.00	6.83	7.00	
International Sugar Feed Co., Minneapolis, Minn.								
Special,...........G. Fair	Holliston	14.50	14.00	4.31	3 50	12.73	12.00	Cottonseed meal, molasses, g'd cleaned grain screenings, g'd clipped oat by-product, salt.
Omaha Alfalfa Milling Co., Omaha, Neb.								
Green Meadow,....H. J. Williams	Lowell	13.71	11.00	0.65	1.00	14.90	25.00	Alfalfa meal, molasses.
M. C. Peters Mill Co., Omaha, Neb.								
Alfalfa Queen.....Ropes Bros.	Salem	13.24	17.00	4.11	3.00	7.59	12.00	Gluten feed, cottonseed meal, corn meal alfalfa, molasses.
Alfal-fat Sugar MealH. K. Webster Co.	Lawrence	11.31	10.00	0.40	0.50	12.53	26.00	Alfalfa meal, molasses.
Arab Horse,........G. B. Brown	Ipswich	11.00	9.00	2.74	2.00	8.99	15.00	Cracked corn, whole oats, alfalfa, molasses.
Arab Horse,........Ropes Bros.	Salem	10.79	9.00	2.47	2.00	9.00	15.00	
June Pasture,.....G. B. Brown	Ipswich	12.71	10 00	0.67	0.50	16.41	26 00	Alfalfa meal, molasses.
June Pasture,......F. A. Fales & Co.	Norwood	13.13	10.00	0.74	0.50	13.96	26.00	
King Corn,........Highland Mills	Newton Hlnds.	11.33	9.00	2.07	1 50	12.93	18.00	Cracked corn, whole oats, alfalfa, molasses.
King Corn,........Ropes Bros.	Salem	11.42	9.00	1.94	1.50	13.46	13.00	
L. C. Prime Co., Boston, Mass.								
Molassine,.........I. Morton & Co.	Plymouth	7.20	7.00	0.30	0.50	6.48	7.00	Sphagnum moss, molasses.
Molassine,.........W. N. Potters Sons	Springfield	8.69	7.00	0.51	0.50	5.23	7.00	
Ralston Purina Co., St. Louis, Mo.								
Purina,...........A. Dodge & Sons	Beverly	11.29	10.00	2.11	2.50	9.90	12.00	Cracked corn, whole oats, alfalfa, molasses.
Purina,...........W. E. Bryant & Co.	Brockton	10.35	10.00	2.20	2.50	8.93	12.00	
Purina,...........W. E. Bryant & Co.	Brockton	10.63	10.00	2.22	2.50	8.27	12.00	

MOLASSES FEEDS—Less than 15% protein (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Ralston Purina Co., St. Louis, Mo.								
Purina, . . . J. Cushing & Co.	Fitchburg	11.00	10.00	2.02	2.50	10.58	12.00	Cracked corn, whole oats, alfalfa, molasses.
Purina, . . . Prentiss Brooks & Co.	Holyoke	9.60	10.00	2.28	2.50	9.36	12.00	
Purina, . . . J. Cushing & Co.	Hudson	10.76	10.00	1.95	2.50	10.17	12.00	
Purina, . . . I. Morton & Co.	Plymouth	10.48	10.00	1.84	2.50	10.53	12.00	
Purina, . . . Prentiss Brooks & Co.	Westfield	9.62	10.00	1.93	2.50	10.17	12.00	
Purina, . . . J. Cushing & Co.	Winchendon	11.28	10.00	1.67	2.50	10.73	12.00	
Western Grain Products Co., Hammond, Ind.								
Hammond Horse, . . Marlboro Grain Co.	Marlboro	12.19	12.00	2.27	2.80	5.80	11.00	Corn, oats, barley, screenings, malt sprouts, linseed meal, molasses, salt.
Hammond Horse, . . Geo. Methe & Sons	Springfield	11.41	12.00	3.32	2.80	6.79	11.00	

MISCELLANEOUS STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
Glen Mills Cereal Co., Rowley, Mass.								
Corn Bran, . . . Glen Mills Cereal Co.	Rowley	10.59	10.00	7.36	7.00	8.54	9.00	
Corn Bran, . . . Glen Mills Cereal Co.	Rowley	10.44	10.00	7.51	7.00	9.00	9.00	
Lexington Grain Co., Lexington, Mass.								
Star Hog Feed, . . . Lexington Grain Co.	Lexington	9.63	8.00	4.45	3.00	6.49	15.00	Wheat middlings, corn meal, mill refuse, mill sweepings, salt.
Star Hog Feed, . . . Lexington Grain Co.	Lexington	13.09	8.00	3.30	3.00	5.43	15.00	
Quaker Oats Co., Chicago, Ill.								
Maz-All Corn Feed, Knight Grain Co.	Newburyport	11.32	9.50	0.78	1.40	0.40	2.00	Corn by-product.

III. POULTRY FEEDS.

MEAT SCRAPS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash. Found.	Ash. Guar.
		%	%	%	%	%	%
First Grade (over 45 per cent protein).							
Andrews & Spellman Co., Providence, R. I.							
Anchor,............N. Paquin & Sons.........	Fall River	51 05	40.00	12.16	10.00	25.24	—
Ideal,............A. M. Reed.............	N. Westport,....	58.93	40.00	12.97	8.00	16.02	—
W. D. Higgins, S. Framingham, Mass.							
"A No. 1".........C. G. Jordan............	Weymouth......	43.17	45.00	12.75	12.00	28.58	—
"A No. 1".........C. G. Jordan............	Weymouth	57.53	45.00	11.27	12.00	20.50	—
Park & Pollard Co., Boston, Mass.							
Blue Ribbon,.......J. Cushing & Co.........	Fitchburg.......	59.89	45.00	13.32	13.00	17.23	—
Richmond Abattoir, Richmond, Va.							
Rava,..............Lexington Grain Co......	Lexington........	85.17	85.00	6.37	7.00	3.44	—
Rava,..............Lexington Grain Co......	Lexington........	87.88	85.00	6.68	7.00	2.12	—
Rava,..............Milford Grain Co.,........	Milford..........	83 89	85.00	7.37	7.00	2.73	—
M. L. Shoemaker & Co., Philadelphia, Pa.							
C. Parkinson...........	Seekonk.........	58.93	55.00	13.42	10.00	15.33	—
H. K. Webster Co., Lawrence, Mass.							
H. K. Webster Co........	Lawrence.... ..	46.40	45.00	11.83	12.00	28.60	—
Whitman & Pratt Rendering Co., Lowell, Mass.							
I. Morton & Co.........	Plymouth	45 37	50.00	15.37	10.00	27.80	—
Sanford Winter Co., Brockton, Mass.							
E. C. Packard...........	Brockton........	63.18	35.00	13.27	15.00	13.13	—
E. C. Packard...........	Brockton........	66.68	35.00	11.67	15.00	11.12	—
Second Grade (below 45 per cent protein).							
Beach Soap Co., Lawrence, Mass.							
Star,..............H. K. Webster Co.........	Lawrence	41.33	40.00	11.39	20.00	36.62	—
Star,..............Dresser Hull Co.,........	Lee.............	36.86	40.00	11.19	20.00	42.03	—
John C. Dow Co., Boston, Mass.							
F. H. Crane & Son......	Quincy Adams...	39.36	43.00	14.67	12.00	33.21	—
J. B. Garland & Son, Worcester, Mass.							
J. B. Garland & Son.....	Worcester... ...	40.23	40.00	17.78	10.00	29.95	—
W. D. Higgins, South Framingham, Mass.							
C. G. Jordan............	Weymouth.. ...	35.46	40.00	13.96	12.00	36.43	—
C. G. Jordan............	Weymouth	34.10	40.00	16.01	12.00	36.11	—
Home Soap Co., Worcester, Mass.							
E. A. Cowee Est.........	Jefferson	39.67	40.00	18.72	12.00	27.04	—
George E. Marsh Co., Lynn, Mass.							
C. G. Jordan............	Weymouth.. ...	40.63	45.00	11.40	10.00	36.05	—
J. A. Torrey, Rockland, Mass.							
No. 1.............A. Culver Co...........	Rockland . .	35.89	40.00	24.18	15.00	23.90	—
Nathan Tufts & Sons, Charlestown, Mass.							
No. 1 . ...N. Tufts & Sons..	Charlestown..	43 78	44.00	11.78	10.00	34.48	—

MEAT AND BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Ash.	
		Found.	Guar.	Found.	Guar.	Found.	Guar.
		%	%	%	%	%	%
Bowker Fertilizer Co., Boston, Mass.							
A. D. Potter	Orange	43.78	40.00	9.92	5.00	31.86	—
A. Culver Co.,	Rockland	44.48	40.00	8.02	5.00	37.87	—
Thomas Hersom & Co., New Bedford, Mass.							
T. Hersom & Co	N. Bedford	36.82	25.00	11.83	5.00	37.54	—
Geo. E. Marsh Co., Lynn, Mass.							
J. Burkhardt	Beverly	33.80	36.00	11.10	8.00	43.90	—
Ross Bros. Co., Worcester, Mass.							
Morse Bros.	Southbridge	34.24	30.00	8.82	10.00	41.72	—
Worcester Rendering Co., Auburn, Mass.							
Morse Bros.	Southbridge	45.75	35.00	10.53	8.00	35.07	—

BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Ash Found.	Ash Guar.
Beach Soap Co., Lawrence, Mass.							
H. Bruckman	Lawrence	10.86	10.00	2.73	8.00	77.49	—
A. L. Warren, Northboro, Mass.							
Bowen & Fuller	Leominster	28.15	26.00	3.53	1.00	55.85	—

BLOOD MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Ash Found.	Ash Guar.
Van Iderstine Co., Long Island City, N. Y.							
Darling's, Bowen & Fuller	Leominster	86.30	80.00	0.21	0.50	4.07	—

FISH MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Ash Found.	Ash Guar.
Joseph Breck & Sons, Boston, Mass.							
W. K. Gilmore & Sons	Walpole	55.04	50.00	1.38	2.00	34.18	—
International Glue Co., Boston, Mass.							
Red Star, Scott Grain Co.	Amesbury	46.55	45.00	1.97	2.00	40.85	—
Red Star, Loham Bros.	Marblehead	50.70	45.00	1.87	2.00	38.67	—

MILK BY-PRODUCT.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Ash Found.	Ash Guar.
Bent & Croissant Co., Antwerp, N. Y.							
Milk Albumen, A. Culver Co.	Rockland	49.74	43.3	0.50	1.00	24.06	—
Milk Albumen, N. C. Whitcher	Stoneham	47.45	43.3	0.57	1.00	21.87	—

ALFALFA MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.
		%	%	%	%	%	%
Consolidated Alfalfa Milling Co., Newton, Kan.							
W. L. Palmer........	Medway........	16.81	14.00	1.71	1.20	26.00	33.00
Cyphers Incubator Co., Buffalo, N. Y.							
W. P. Barney..........	Seekonk.......	12.17	12.00	1.30	1.00	32.61	30.00
Albert Dickinson Co., Chicago, Ill.							
Eastern Grain Co........	Bridgewater.....	12.52	12.00	1.22	1.00	31.87	35.00
Eastern Grain Co........	Bridgewater....	14.36	12.00	2.60	1.00	25.43	35.00
Bryant Haywood, Kansas City, Mo.							
Chickalfa,.........Lexington Grain Co......	Lexington.......	22.16	20.00	2.34	2.00	15.93	30.00
Kornfalfa Feed Milling Co., Kansas City, Mo.							
Pioneer,...........C. S. Barber.............	Bernardston.....	13.49	12.00	1.52	1.50	30.37	35.00
Pioneer,...........J. Shea.................	Lawrence.......	14.28	12.00	1.66	1.50	29.40	35.00
Park & Pollard Co., Boston, Mass.							
Hoosac Val. Coal & G. Co.	Adams........	16.42	12.00	1.71	1.50	23.81	30.00
D. B. Hodgkins Sons.....	Manchester.....	15.79	12.00	2.50	1.50	26.19	30.00
Quaker Oats Co., Chicago, Ill.							
Knight Grain Co.........	Newburyport ..	14.66	14.00	1.08	2.00	23.29	25.00
Russell Grain Co., Kansas City, Mo.							
Square Deal,.......Warren Grain Co.........	Warren.........	14.71	12.00	1.80	1.80	28.52	25.00

POULTRY MASH AND MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Local Mixtures.								
Dry Hen Feed, C. S. Barber	Bernardston	21.28	19.00	5.20	4.00	9.79	10.00	Oats, alfalfa, gluten feed, wheat bran, linseed meal, flour middlings, beef scraps.
Berkshire Me. Mash Berkshire Coal & Grain Co.	N. Adams	18.21	20.00	4.56	4.00	7.13	5.00	Corn meal, cottonseed meal, alfalfa meal, wheat bran and middlings, beef scraps.
Dry Mash, H. Bruckman	Lawrence	20.49	15.00	3.32	7.00	7 43	15.00	Wheat bran and middlings, corn meal, linseed meal, gluten feed, beef scraps, alfalfa.
Morning Mash, W. E. Bryant & Co.	Brockton	18.74	14.00	4.86	5.00	7.81	9.00	Alfalfa meal, wheat bran and middlings, beef scraps, charcoal, ground oats, gluten feed, corn meal.
Morning Mash, W. E. Bryant & Co.	Brockton	18.87	14.00	4.91	5.00	7.40	9.00	
Morning Mash, Bryant & Soule	Middleboro	15.80	14.00	5.20	5.00	7.80	7.00	Corn meal, ground oats, beef scraps, charcoal, wheat bran, alfalfa meal.
Morning Mash, Bryant & Soule	Middleboro	15.94	14.00	4.85	5.00	7.39	7.00	
Climax Dry Ration, E. A. Cowee Est.	Worcester	23.03	20.00	5.22	3.50	6.21	10 00	Wheat bran and middlings, oats, barley, corn, gluten feed, alfalfa meal, linseed meal, meat and bone meal, fish scraps, salt.
Climax Grow. Feed, E. A. Cowee Est.	Worcester	15.68	14.00	4.97	4.00	4.57	5.00	Wheat bran and middlings, corn, oats, barley, hominy feed, meat and bone meal, salt, locust bean meal, linseed meal.
King Mash, Cutler Co.	N. Wilbraham	20.05	18.00	4.22	3.00	6.86	11.00	Alfalfa meal, corn feed meal, wheat meal, cottonseed meal, ground corn bran, wheat bran, beef scraps, linseed meal.
Davies Dry Mash, Rees W. Davies	Greenfield	15.81	17.00	5.81	5.00	5.91	8.00	Corn meal, ground oats, linseed meal, hominy meal, meat scraps, alfalfa meal, wheat middlings, Heneta grit, salt.
Climax Crm. Mash, J. W. Day & Co.	Lynn	27.49	24.00	5.76	5.00	6.50	7.00	Corn meal, gluten feed, wheat bran and middlings, meat scraps, bone, alfalfa, milk albumen.
Climax Meat Mash, J. W. Day & Co.	Lynn	18.39	17.50	4.23	3.50	7.75	7.00	Corn meal, wheat bran and middlings, oats, gluten feed, alfalfa, fish, meat scraps, charcoal.
Climax Grow. Feed, J. W. Day & Co.	Lynn	20.05	20.00	5.32	5.00	4.11	4.50	Corn meal, hominy feed, oats, wheat bran and middlings, meat scrap, bone, fish, milk albumen
Fish Mash, Greene Chicken Feed Co.	Marblehead	12.34	12.00	3.00	3.00	8.03	5.50	Fish scrap, meat and bone meal, corn, wheat bran, barley, corn cockle, alfalfa, yellow foxtail, winter rape, flaxseed, oats, shell lime, mustard, salt, speltz.
Poultry Mash, S. B. Green & Co.	Watertown	23.99	20.00	4.47	4.00	6.68	7.00	Meat scraps, fish scraps, wheat bran, gluten feed, linseed meal, corn meal, wheat middlings, alfalfa.
Poultry Mash, S. B. Green & Co.	Watertown	23.99	20.00	4.45	4.00	6.65	7.00	

POULTRY MASH AND MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Wadsworth Mixture D. B. Hodgkins Sons	Manchester	19.18	13.00	4.63	4.00	8.36	7.00	Wheat bran and middlings, corn meal, alfalfa meal, beef scraps, rolled oats, ground oats, linseed meal, gluten feed.
Dry Mash, Hoosac Val. Coal & Gr. Co.	Adams,	16.95	15 00	4.09	4.00	8.08	10.00	Wheat bran and middlings, corn meal, alfalfa
Dry Mash, Hoosac Val. Coal & Gr. Co.	Adams	23.38	15.00	4.92	4.00	6.99	10.00	meal, wheat meal, cottonseed meal.
Dry Mash, Jaquith & Co.	Woburn,	15.76	16.00	3.62	4.00	5.38	6.00	Wheat feed, rolled oats, alfalfa, milk albumen, beef scraps, meat and bone, corn, linseed meal, gluten feed.
Dry Mash, Jaquith & Co.	Woburn,	17.16	16.00	4.93	4.00	7.40	6.00	
Alfalfa Mash, Lexington Grain Co.	Lexington	21.10	15.00	3.94	3.00	5.42	12.00	Alfalfa meal, meat scraps, fish scraps, corn meal, gluten feed, wheat middlings and bran, grain cleanings, salt.
Lex. Poultry Mash, Lexington Grain Co.	Lexington	25.04	18.00	5.26	3.00	5.79	9.00	Alfalfa meal, meat scraps, fish scraps, corn meal, gluten feed, wheat bran and middlings, linseed meal, salt.
Lex. Poultry Mash, Lexington Grain Co.	Lexington	22.64	18.00	4 12	3.00	5.95	9.00	
Dry Mash, Morse Bros.	Southbridge	23.47	20.00	3.85	3.00	10.08	12.00	Beef scraps, animal meal, fish scraps, gluten meal, linseed meal, gluten feed, alfalfa, wheat bran, corn meal, g'd oats, charcoal.
Dry Mash, G. H. Reed	S. Acton	21.89	23.03	5.30	5.09	7.55	7.80	Wheat bran and middlings, corn, gluten feed, linseed meal, alfalfa, meat scrap.
Poultry Hash, Ropes Bros.	Salem	19.18	13.00	4.08	4.50	6.98	11.00	Shredded wheat waste, hominy meal, linseed meal, gluten feed, alfalfa, mixed feed, bone meal, rolled oats.
Oxford Meat Mash, Torrence Vary & Co.	Lynn	18.13	15.00	4.61	4.00	7.88	12.00	Wheat bran and middlings, corn, oats, wheat, alfalfa, meat, bone, salt.
Dry Mash, H. K. Webster Co.	Lawrence	19.09	20.00	4.20	3.00	6.89	10.00	Wheat feed, alfalfa, gluten feed, rolled oats,
Dry Mash, H. K. Webster Co.	Lawrence	19.96	20.00	3 50	3.00	4.18	10.00	corn meal, beet pulp, linseed meal, beef scraps.
W. & H. Dry Mash, Wilson & Holden	Worcester	21.63	20.00	5.35	3.50	6.35	10.00	Wheat bran, oats, barley, corn meal, wheat middlings, alfalfa meal, linseed meal, meat and bone meal, fish scraps, salt.
Buffalo Cereal Co., Buffalo, N. Y.								
F. H. Crane & Sons	Quincy Adams.	16.46	15.00	5.23	4.00	5.28	5.00	Corn, hominy feed, wheat bran, wheat middlings, gluten feed, rolled oats.
Chas. M. Cox Co., Boston, Mass.								
Wirthmore G. Feed, W. K. Gilmore & Sons	Wrentham	10.88	12.00	3.17	5.00	2.65	4.50	Corn meal, oats, wheat.

POULTRY MASH AND MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Cutler Co., No. Wilbraham, Mass.								
Cutler Co.	S. Framingham	19.00	18.00	3.52	3.00	8.60	11.00	Alfalfa meal, corn feed meal, wheat meal, cottonseed meal, ground corn bran, wheat bran, beef scraps, linseed meal.
E. A. Cowee Est., Worcester, Mass.								
Climax, I. J. Rowell,	Pepperell	23.34	20.00	5.48	3.50	5.99	10.00	Wheat bran, oats, barley, gluten feed, corn meal, wheat middlings, alfalfa meal, linseed meal, meat and bone meal, fish scrap, salt.
Climax, I. J. Rowell	Pepperell	23.12	20.00	5.39	3.50	5.74	10.00	
Albert Dickinson Co., Chicago, Ill.								
Queen, F. A. Fales & Co.	Norwood	10.79	11.00	3.03	2.50	7.30	10.00	Alfalfa meal, corn feed meal, wheat meal, ground corn bran, wheat bran, beef scraps, linseed cake, salt.
Globe Elevator Co., Buffalo, N. Y.								
Blue R. Lay. Mash, A. M. Haggart	Franklin	18.91	20.00	5.40	3.00	8.82	10.00	Wheat bran, middlings and flour, g'd oats, corn meal, gluten meal, alfalfa, linseed meal, meat meal, fish scraps, g'd bone, salt.
Greene Chicken Feed Co., Marblehead, Mass.								
Fish Mash, Knight Grain Co.	Newburyport	13.51	12.00	2.57	3.00	5.10	5.50	Fish scraps, meat and bone meal, corn, wheat bran, barley, alfalfa, rape, flaxseed, oats, shell lime, mustard, salt, speltz, weed seed.
Wm. S. Hills Co., Boston, Mass.								
Purity, Bowen & Fuller	Leominster	18.83	17.00	3.77	4.00	7.83	9.00	Beef scraps, linseed meal, alfalfa, meal, cottonseed meal, wheat bran, corn meal, wheat, g'd oats, barley, fish scraps.
Purity, F. J. Williams	Lowell	19.79	17.00	5.88	4.00	6.62	9.00	
Purity, Wm. C. Brett	N. Abington	13.60	17.00	2.83	4.00	4.18	9.00	
H-O Co., Buffalo, N. Y.								
Dry Mash, A. T. Butler	Adams	14.89	18.00	3.91	3.50	10.00	9.00	Oat middlings, gluten feed, wheat middlings, rolled oats, alfalfa, corn meal, hominy feed, cracked wheat, wheat bran.
Dry Mash, A. T. Butler	Adams	20.05	18.00	3.19	3.50	11.76	9.00	
Dry Mash, Beaver Coal & Grain Co.	Norwood	17.55	18.00	4.08	3.50	11.05	9.00	
Poultry Feed, A. T. Butler	Adams	18.13	17.00	5.02	5.50	6.42	9.00	Oat middlings, rolled oats, gluten feed, wheat bran and middlings, hominy feed.
Poultry Feed, Lenox Coal Co.	Lenoxdale	17.60	17.00	5.15	5.50	6.66	9.00	
Husted Milling Co., Buffalo, N. Y.								
Laying Mash, H. L. Patrick	Hopedale	15.94	15.00	4.61	3.00	5.09	8.00	Corn meal, rolled oats, wheat bran and middlings, cottonseed meal, gluten feed.

POULTRY MASH AND MEAL (Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber. Found.	Fiber. Guar.	Certified Ingredients.
		%	%	%	%	%	%	
Mystic Milling & Feed Co., Rochester, N. Y.								
Puritan Mash,......W. P. Griffin	Pittsfield..	24 69	23 00	4.46	7.00	8.35	3.00	Wheat bran and middlings, corn meal, linseed meal, gluten feed, alfalfa meal, bone meal, meat meal, blood meal.
Park & Pollard Co., Boston, Mass.								
Dry Mash.........A. C. Brown	Lynn....	21 10	15.00	3.93	3.50	5.41	12.00	Wheat bran and middlings, corn, wheat, oats, barley, Kaffir corn, buckwheat, alfalfa, fish, meat, bone, beet pulp, salt.
Dry Mash,........F. A. Fales & Co.	Norwood	15 97	15.00	6.17	3.50	6.90	12 00	
Dry Mash,........W. P. Barney....	Seekonk.	20 58	15.00	3.22	3.50	5.01	12 00	
W. N. Potter & Sons, Greenfield, Mass.								
Green River Mash,.A. D. Potter......	Orange...	16 11	15.00	4.06	4.00	6.48	11.00	Hominy, oats, gluten feed, linseed meal, wheat feeds, alfalfa.
Green River Mash,.A. D. Potter......	Orange...	15.24	15.00	4.29	4.00	6.18	11.00	
Pratt Food Co., Philadelphia, Pa.								
Baby Chick Food,..B. W. Brown	Concord..	15 15	13 00	5.05	4.75	2.03	3.00	Hulled oats, corn meal, epsom salts, bone meal, wheat middlings, cooked wheat, pepper, gentian, millet, ginger, rape, caraway, shell meal.
Providence Seed Co., Providence, R. I.								
I. X. L. Grow. Feed.W. P. Barney.....	Seekonk..	12 50	11.50	4.55	3.50	7.23	8.00	Alfalfa, g'd oats, corn meal, wheat middlings, beef scraps.
I. X. L. Mash Food,W. P. Barney....	Seekonk..	9.90	10.00	4.12	3.50	5.60	7.00	Corn meal, wheat, oats, barley.
Ralston Purina Co., St. Louis, Mo.								
Chicken Chowder,..A. Dodge & Son	Beverly..	19 26	17.00	3.82	3.00	7.70	9.00	Wheat bran and middlings, corn meal, charcoal, alfalfa meal, linseed meal, granulated meat.
Quaker Oats Co., Chicago, Ill.								
American,.........J. W. Doon & Son	Natick.....	14.80	12.00	6.05	3 50	4.54	9.00	Corn meal, barley meal, cottonseed meal, wheat mixed feed, rye shorts.
Ross Bros. Co., Worcester, Mass.								
Wyandotte,........V. E. Moore.. ...	Springfield	15.15	15.00	3.83	3.75	8.73	8.75	Wheat bran and middlings, corn meal, gluten feed, beef scraps, fish scraps, alfalfa meal, linseed meal.
Vincent Bros., Bridgeport, Conn.								
V. B. Mash,.......A. B. Dunham......	Sheffield...	22.55	21.50	3.95	4.90	9.24	10.20	Wheat bran, corn meal, wheat middlings, gluten feed, alfalfa meal, g'd oats, beef scraps.

DISCUSSION OF THE INSPECTION.

I. Protein Feeds.

Cottonseed Meal. Pages 5-7.

Cottonseed meal is the ground cake resulting from the extraction of cottonseed oil from the kernel of the cotton seed. Its protein content and digestibility are lowered in proportion to the amount of the hulls or hard outer covering of the seed remaining in the cake or added to it after grinding. Where none of the hull is removed, or enough is left to bring the protein content below 36 per cent, the product is known as cottonseed feed. In purchasing, preference should be given to those brands running uniformly low in fiber and high in protein. Cottonseed meal containing a large amount of lint should also be avoided as being inferior in feeding value.

Cottonseed meal is one of the cheapest sources of protein and, on account of the nitrogen and phosphates which it contains, has a manurial value greater than any other feed. Two to three pounds daily fed with other more bulky feeds is usually considered more satisfactory than larger amounts. Cottonseed meal has a tendency to make hard, firm butter.

Most of the cottonseed meal found on the market was of good quality. Occasional samples were found below guarantee and, in the future, more attention will be paid to these inferior articles.

Cottonseed feed (meal and hulls) cannot be considered economical for the northern feeder. The hulls do not have a digestibility equal to good timothy hay. They should be utilized in the South, where the cost of transportation is not a factor in fixing the price. The "Royal" brand of cottonseed feed ran uniformly high in fiber content, which detracted from its feeding value.

Average Analyses and Retail Prices.

	High Grades (Choice). 1911.	Medium Grades (Prime and Good). 1911.	High and Medium Grades. 1911.
No. Samples,	15	15	30
Protein (per cent),	42.37	39.69	41.03
Fat (per cent),	8.38	8.07	8.23
Fiber (per cent),	6.86	8.54	7.70
Price a ton,	$34.36	$33.84	$34.06

	1912.	1912.	1912.
No. Samples,	42	22	64
Protein (per cent),	42.06	39.10	41.04
Fat (per cent),	7.83	7.57	7.74
Fiber (per cent),	7.86	9.36	8.38
Price a ton,	$34.70	$33.85	$34.40

	1913.	1913.	1913.
No. Samples,	31	56	87
Protein (per cent),	42.56	38.86	40.18
Fat (per cent),	7.56	7.79	7.71
Fiber (per cent),	7.79	9.90	9.15
Price a ton,	$34.47	$34.56	$34.53

It is worthy of note that the medium grades sold for as much money at retail as the high grades. Query!! Is the buyer sufficiently careful when purchasing?

Linseed Meal.
Page 8.

Linseed meal was, or at least could have been, sold during the past season at a retail figure which would make it an economical feeding stuff. In many cases, for reasons best known to the retailers, the same price was maintained as in the previous season. Linseed meal, when fed in moderate amounts, is an excellent food for all classes of livestock, although when used to any extent for dairy cows it has a tendency to make the butter soft and salvy. It approaches cottonseed meal in feeding value.

The terms "new process" and "old process" refer to the method of extracting the oil, the "old process" meal containing noticeably more oil than the "new process." The difference in feeding value is not worth consideration. While oil meal is very seldom adulterated, a number of instances have been noted where the meal has contained a considerable amount of screenings.

The terms "oil cake" and "oil meal" are quite generally used for linseed oil cake or linseed meal. The writer believes that the latter terms are preferable.

Average Analyses and Retail Prices.

New Process.

	1910.	1911.	1912.	1913.
No. Samples,	5	2	5	4
Protein (per cent),	37.96	39.95	37.10	37.21
Fat (per cent),	2.50	2.70	2.31	2.31
Fiber (per cent),	—	7.20	8.29	8.59
Price a ton,	$37.80	$39.00	$41.60	$39.00

Old Process.

	1910.	1911.	1912.	1913.
No. Samples,	17	8	18	31
Protein (per cent),	35.96	37.11	35.61	34.56
Fat (per cent),	6.10	5.76	6.72	6.74
Fiber (per cent),	—	7.15	7.45	7.76
Price a ton,	$10.65	$10.50	$13.29	$10.03

Gluten Meal.
Page 9.

Gluten meal, a by-product from the manufacture of starch from corn, is again in the market after a lapse of several years. On the basis of its composition and digestibility, it has 10 per cent greater feeding value than cottonseed meal. It should not be confused with gluten feed, which has noticeably less protein.

Average Analysis and Retail Price.

	1913.
No. Samples,	9
Protein (per cent),	41.88
Fat (per cent),	2.18
Fiber (per cent),	2.31
Price a ton,	$36.00

Gluten Feed.
Pages 9-10.

Gluten feed is a mixture consisting largely of gluten meal, corn bran, broken corn germs and other residual material derived from Indian corn in the manufacture of cornstarch. It varies much in color and acidity, depending upon the method of manufacture, condition of the seed from which it is derived, the use of added coloring matter and the addition or omission of the condensed "steep water." The last mentioned is a very dilute solution of sulfurous acid in which the corn is soaked preparatory to separating the starch. This steep water dissolves out considerable of the proteids and phosphates. Formerly this material was allowed to run to waste, but in many factories it is now condensed, the acid neutralized, and the residue added to the gluten feed. The addition of this residue increases the ash and protein content of the feed but does not improve its physical appearance.

At a meeting of the Association of Feed Control Officials, held in 1913, it was voted not to recognize the terms "gluten feed" and "gluten meal" but in their place to substitute "cornstarch by-product with corn bran" for gluten feed, and "cornstarch by-

product without corn bran" for gluten meal. While this action can merely be considered advisory, a number of feed control officials in other states have adopted the nomenclature. The above information is stated here for the benefit of the reader.

Gluten feed is a satisfactory and economical feed for stock when fed in conjunction with other concentrates. It is not always found palatable when fed alone.

Average Analyses and Retail Prices.

	1911.	1912.	1913.
No. Samples,	11	30	41
Protein (per cent),	25.77	25.64	25.71
Fat (per cent),	3.35	2.57	3.24
Fiber (per cent),	6.42	6.63	6.67
Price per ton,	$28.88	$32.86	$31.96

Distillers' Dried Grains.
Pages 10-11.

Distillers' grains are the by-product from the manufacture of distilled liquors from the cereal grains. The nature of the process is such that practically all of the starch and a considerable proportion of the soluble carbohydrates are removed from the grain, rendering the residue, known as distillers' grains, rich in protein, fiber and fat.

Distillers' grains made from corn contain the most protein, while grains derived from rye, the least. Grains consisting of mixtures of rye and corn have a protein content in proportion to the relative amounts of the two grains used.

Good corn grains contain from 28 to 32 per cent protein (while rye grains contain about 15 per cent) and have a feeding value substantially equal to gluten feed. Its bulky nature enhances its value as a grain feed for all kinds of stock. From 2 to 4 pounds daily, preferably mixed with other grain, is the usual feed for dairy animals.

Popular opinion notwithstanding, the flavor and keeping quality of the milk does not appear to be affected when this food constitutes as high as one-half of the grain ration.

Continental Gluten Feed is a corn distillers' grain and not what is generally known as gluten feed.

Average Analyses and Retail Prices.
Corn Distillers' Grains.

	1910.	1911.	1912.	1913.
No. Samples,	14	7	22	34
Protein (per cent),	29.67	30.17	30.82	31.04
Fat (per cent),	11.16	11.84	11.64	10.75
Fiber (per cent),	12.24	11.16	10.64	11.37
Price a ton,	$33.73	$32.66	$34.68	$34.53

Brewers' By-products. Page 11.

Malt sprouts and brewers' grains are found on the market more often as a component of stock and molasses feeds than as a feed by themselves. This probably is due to the fact that they are excellent absorbents for molasses and when fed by themselves are rather unpalatable to most animals. Brewers' grains at prices usually prevailing are an economical and satisfactory food for either horses or dairy animals.

Malt sprouts are more satisfactory as a food for dairy stock and, if fed in excess of 2 pounds daily, should be moistened with several times their weight of water.

Average Analyses and Retail Prices.

Malt Sprouts.

	1910.	1911.	1912.	1913.
No. Samples,	8	5	17	4
Protein (per cent),	26.72	26.14	25.94	27.55
Fat (per cent),	1.01	1.01	1.45	1.14
Fiber (per cent),	12.58	12.98	11.19	13.13
Price a ton,	$27.81	$26.50	$26.31	$28.20

Brewers' Grains.

	1910.	1911.	1912.	1913.
No. Samples,	2	1	3	9
Protein (per cent),	30.35	25.54	26.52	25.63
Fat (per cent),	6.81	6.77	5.87	5.93
Fiber (per cent),	12.95	15.35	13.85	13.96
Price a ton,	$30.00	$27.00	$28.33	$29.43

Wheat By-products. Pages 12-22.

Wheat by-products are more generally distributed than any other class of concentrates.

Wheat middlings vary in quality from Red Dog or low-grade flour to standard or brown middlings which contain very little, if any, flour. The digestibility of middlings depends, to a considerable extent, upon the amount of flour they contain; flour middlings having about 10 per cent greater feeding value than standard middlings. The difference in wholesale price between flour and standard middlings is generally in proportion to their food value.

Wheat mixed feed is theoretically the entire residue of the wheat kernel left after separating the commercial flour. Some millers have the mistaken idea that wheat mixed feed should also

legitimately contain all of the screenings, dirt and chaff purchased with the wheat regardless of quality. Wheat mixed feed may be the so-called "mill run" or it may be a mixture of bran and Red Dog put out by a jobber or wholesaler. A difference of 10 per cent in the feeding value is frequently noted between different samples of mixed feed, depending upon the amount of flour contained in the different brands.

Some brands contained enough screenings to be considered adulterated, but, in keeping with our policy of not entering cases for prosecution during the year just past, offenders were simply warned. In a number of instances wheat feeds were guaranteed as containing screenings, which complies with the requirements of the Massachusetts law.

Wheat bran has from 5 to 10 per cent less feeding value than wheat mixed feed. From the standpoint of nutrition, wheat bran cannot usually be considered economical, but on account of its beneficial effect on the animal, it is usually used as a component of the dairy ration and is also quite generally used as an occasional feed for horses. On account of its fiber content, it will not prove as valuable for hog feeding as middlings.

The remarks in regard to screenings in wheat mixed feed apply with equal force to wheat bran.

All of the wheat by-products ran quite uniformly true to guarantee in regard to protein, fat and fiber.

Average Analyses and Retail Prices.

Wheat Middlings.

	1910.	1911.	1912.	1913.
No. Samples,	70	37	38	64
Protein (per cent),	17.88	—	17.74	17.88
Fat (per cent),	5.18	—	5.04	5.17
Fiber (per cent),	—	—	5.83	5.76
Price a ton,	$31.59	$30.62	$33.66	$32.20

Wheat Mixed Feed.

	1910.	1911.	1912.	1913.
No. Samples,	163	76	138	184
Protein (per cent),	16.97	—	16.99	16.91
Fat (per cent),	4.71	—	4.59	4.71
Fiber (per cent),	—	—	7.01	7.27
Price a ton,	$29.93	$29.51	$32.19	$30.73

Wheat Bran.

	1910.	1911.	1912.	1913.
No. Samples,	63	23	28	57
Protein (per cent),	16.50	—	16.47	15.86
Fat (per cent),	4.86	—	4.28	4.72
Fiber (per cent),	—	—	8.73	9.48
Price a ton,	$28.68	$28.30	$31.58	$28.18

Rye Feeds. **Page 22.**

Rye feeds, the residue from the milling of rye, are found to a limited extent in the Massachusetts market. They contain a little less protein and rather more starchy matter than wheat middlings, but have a feeding value substantially equivalent to the latter. The samples collected were quite uniform and noticeably overran their guarantees.

Wheat Feeds with Admixtures. **Page 23.**

Wheat bran and corn-and-cob meal mixtures have been on the market for a number of years and have usually sold at a price in excess of their feeding value. These mixtures retailed at about the price of wheat bran. One thousand pounds of wheat bran, from 500 to 750 pounds of ground corncobs and from 250 to 500 pounds of corn meal would give a mixture analyzing approximately the same as feeds of this character. In other words, in every ton of this material the feeder purchases, he is paying wheat bran prices for from 500 to 750 pounds of corncobs.

Buckeye feed is a mixture of wheat products and rye shorts. Its feeding value was equal to good wheat mixed feed. It overran its protein guarantee from 4 to 5 per cent.

Dairy and Horse Feeds (more than 15 per cent Protein). **Pages 23-25.**

Under this heading are grouped those feeds which contain more than 15 per cent of protein and are mixtures of several feeding stuffs. They usually purport to be complete grain rations for either dairy stock or horses, as designated. These mixtures vary to a considerable extent in chemical composition as well as in the ingredients of which they are composed. There is no apparent relation between the chemical composition, ingredients, and the selling price. Under the present law the buyer is able to know the character of the goods offered for sale and need not be misled by extravagant claims often made for inferior products. The feeder ought to consider the retail prices of the several ingredients before purchasing the

feeding mixture. Some of them contain only high-grade material while others contain low-grade milling offal in addition. Prices being equal, preference should be given to those feeds free from inferior products.

In general it may be said that the quality of this class of feed stuffs has noticeably improved during the last few years. Some of the more prominent of these feeds are known under the brand names of Bibby's Oil Cake Dairy and Horse Feeds, Union Grains, Unicorn Ration, Buffalo Cereal Co. Creamery Feed, Wirthmore Balanced Ration, and Larro Feed.

Molasses Feeds.
Pages 26-27.

The history of molasses feeds has been one of progress. The first feeds of this character brought into the New England markets were in poor mechanical condition, did not keep well because of excessive moisture, and also contained a multitude of viable weed seeds. In addition to this they were misrepresented as being complete balanced rations for any or all farm animals; furthermore, they were often sold by the retailer at a figure that gave him a large profit.

Under present conditions, practically all of the molasses feeds found in Massachusetts markets that contain at least 15 per cent protein are in good mechanical condition, do not contain an excessive amount of water and have the screenings, if they contain any, so finely ground as to destroy their germinating qualities. The more progressive manufacturers and agents also assign them to their proper place and do not claim for them all of the properties of a balanced ration, but advocate their use in conjunction with other feeding stuffs. When sold at a price not in excess of wheat bran, the better grades of molasses feeds should form a satisfactory substitute for it in the ration, provided they do not contain over 10 per cent of fiber. The samples collected and here reported practically all fully maintained their guarantees.

Calf Meals.
Pages 27-28.

All of these meals will undoubtedly serve as a partial milk substitute for calves intended for dairy purposes; it is best not to begin to use these meals until the calf is about three weeks old. A satisfactory calf meal should be finely ground and composed of clean, easily digested material free from taint and any noticeable amount of fiber.

Miscellaneous Protein Feeds. Page 28.

A few feeds that do not find a place in our regular classification are listed here. None of them are found generally distributed.

Cracker-Jack Feed was as guaranteed—ground wheat and flax screenings.

Bibby's Pig Meal is an English product, having a limited sale in Massachusetts.

Argo Corn Oil Meal is the residue derived from the corn germ after extracting the oil.

CXX Feed is a by-product from the manufacture of Postum. The result of a digestion experiment made at this station indicates it to have a low feeding value.

Puffed Wheat Meal is the residue resulting from the manufacture of puffed wheat (dust, broken kernels, etc.).

II. Starchy (Carbohydrate) Feeds.

Meals Made from Cereal Grains. Pages 29-30.

The meals made from corn, oats and rye were examined but, when pure, were not required to be guaranteed by the Massachuestts law.

Much of the corn meal, particularly that manufactured west of Massachusetts, does not consist of the entire seed but is made from that part of the kernel left after the manufacture of cracked corn or table meal. In feeding value such meal is equal to that made from the entire seed.

Average Analyses and Retail Prices.

	1910.	1911.	1912.	1913.
No. Samples,	51	19	53	20
Protein (per cent),	8.55	8.17	8.87	9.05
Fat (per cent),	3.81	2.77	3.65	3.78
Fiber (per cent),	1.84	1.58	1.85	2.04
Price a ton,	$29.28	$24.10	$31.44	$25.92

The cereal meals are all valuable sources of digestible carbohydrates, corn meal being usually the most economical. Rye, being rather less palatable, is less desirable than either oats or corn.

Hominy Meal.
Pages 30-31.

Hominy meal is derived from white corn, although yellow hominy is occasionally found on the market. Hominy meal consists of the softer parts of the corn kernel together with the corn germ separated in the manufacture of hominy grits. While slightly less digestible than corn meal, the fact that it contains rather more protein and fat and that it is kiln dried and almost invariably sweet, makes it a more desirable feed than corn meal when it can be purchased for about the same price. Recently a number of manufacturers have employed a process for extracting a part of the corn oil from the germ which gives the hominy feed a lower fat content. A good quality of hominy should contain about 10 per cent of protein and not over 5 per cent of fiber. The 56 samples herein reported show an average of 10.78 per cent of protein and 7.3 per cent of fat and indicate that the hominy feed offered in Massachusetts is of excellent quality.

Average Analyses and Retail Prices.

	1910.	1911.	1912.	1913.
No. Samples,	62	21	50	67
Protein (per cent),	10.29	10.55	10.78	10.78
Fat (per cent),	7.94	7.79	7.54	7.29
Fiber (per cent),	4.21	3.87	3.68	3.85
Price a ton,	$30.13	$26.62	$33.15	$30.85

Provender.
Page 32.

Provender, as understood locally, is a mixture of straight corn and oats ground together. It cannot be considered an economical feed for dairy stock and is more generally used in feeding horses. There are a number of so-called corn-and-oat feeds on the market consisting of either hominy feed or corn meal and oat feed that will prove fully as satisfactory for horse feeding as provender when sold at the same or a smaller figure.

Dried Beet Pulp.
Page 32.

Dried beet pulp is the residue obtained in the manufacture of sugar from the sugar beet. Experiments have shown it to be nearly equal in feeding value to a like amount of corn meal. Its mechanical condition and its ability to absorb large amounts of water render it quite satisfactory as a substitute for corn silage, providing the latter is not available. From 8 to 10 pounds can be fed daily mixed with 2 to 3 times its weight of water.

Breeders of pure-bred livestock find the moistened pulp excellent for feeding cows on forced tests in connection with large amounts of grain, as it has a tendency to keep the bowels open and is not likely to produce digestive disturbances.

Stock and Horse Feeds. Pages 33-37.

Feeds of this character usually consist of fibrous cereal residue from the milling of corn, oats or barley, together with several concentrates such as hominy, corn meal, cottonseed meal and gluten feed. Alfalfa and a flax by-product consisting of the waste stalks and pods of the flax plant are sometimes incorporated. The last named product, judging from samples analyzed at the experiment station, does not have a feeding value very much in excess of rye straw.

Stock and horse feeds cannot be considered as economical sources of digestible carbohydrates as corn meal, hominy meal or beet pulp. Brands that are clean and sweet and do not cost any more, nor contain more fiber than oats or provender, may be considered satisfactory substitutes.

If the reader desires to purchase such feeds, he is advised to study the analyses given on pages 33-37 and buy those brands that contain the lowest percentage of fiber and the highest percentage of protein.

Molasses Feeds (less than 15 per cent Protein). Pages 37-39.

These feeds differ from the molasses feeds already mentioned in containing less than 15 per cent protein. They contain considerable amounts of alfalfa in addition to molasses and are intended primarily for horses. The writer does not believe that the addition of alfalfa meal to a molasses feed will prove economical. Alfalfa is an excellent source of roughage, but the consumer cannot afford to purchase it at prices asked for concentrates; neither will it serve as a substitute for the more highly digestible grains.

Germaline Meal is a mixture of corn meal and molasses. It has been found on the market in years past containing varying percentages of water. When too moist, it has a tendency to ferment; when well dried, it is at least equal to corn meal in feeding value.

International Special and *Hammond Horse Feeds* are both typical molasses feeds containing ground grain screenings.

Oatmolene Horse Feed consists of ground oats, cracked corn, wheat bran and molasses. At the prices for which it was sold during the past year it can be considered a satisfactory and economical horse feed.

Molassine Meal, of which 2 samples are reported, conformed to its guarantee. It is composed of substantially 25 to 30 per cent of sphagnum moss and 70 to 75 per cent of cane or beet molasses. The moss, according to the manufacturers, comes from the upper layers of large bogs in Yorkshire, England. Such material, as time passes, decays and forms peat. It is doubtful if the moss has any particular nutritive properties; hence, the nutritive value of the feed consists in the amount of molasses present.* The larger part of the crude protein found in Molassine Meal exists in the form of amids. Experiments made at this station show that at the same moisture content one ton of Molassine Meal contains substantially 900 pounds of digestible organic matter as against 1400 pounds for corn meal. On this basis Molassine Meal would have scarcely two-thirds of the nutritive value of the corn. An experiment with milch cows was made in which 4.3 pounds of corn meal were fed against 4.3 pounds of Molassine Meal. The cows yielded some 14 per cent more milk on the ration of which corn meal was a component.**

The value of small amounts (2 pounds daily) of molasses as an appetizer for animals out of condition, as a colic preventive, and to facilitate the disposal of unpalatable and inferior roughage, has been repeatedly referred to in the reports and bulletins of this station. It has been shown to depress or lessen the digestibility of the feeds with which it is fed. It has a tendency to give a glossy coat especially to run-down or overworked horses.

Molasses may improve the condition of the intestinal tract of *animals that are out of condition* so that they will be able to assimilate their food to better advantage. The writer is of the opinion, however, that molasses, from the standpoint of nutrition, is not an economical feedstuff for northern feeders.

Moss or peat has proved its worth as an excellent absorbent for molasses, rendering the latter easily handled and transported. European investigators seem to have recognized that the peat has a tendency to check the laxative effect of molasses, not because

*Kellner and Pfeiffer have shown that peat is without nutritive value.

**This amount of Molassine (4.3 pounds daily) constituted 54 per cent of the total grain ration. The manufacturers claim that the grain ration should not contain over 25 per cent of Molassine, in which case the milk yield would be increased. The consumer is left to draw his own conclusions.

of the action of humic acid in neutralizing the potash and thus setting up "the essential chemical change," but because of the absorptive properties of the peat in retaining the alkaline salts in the manure, and the action of the tannic acid contained in many varieties of peat.

While molasses mixed with moss or peat (of which Molassine Meal is a type) renders the former easily handled, and while such a mixture may be used to advantage in some cases, it is believed that at prevailing prices it is a decidedly expensive feed stuff.

III. Poultry Feeds.

Animal Products. Pages 40-41.

The meat scraps found on the market varied widely in price without particular reference to their quality or chemical composition. The purchaser should note the guarantee and also satisfy himself that the article is clean and reasonably free from taint before buying. Meat scraps are purchased for the protein or meat they will furnish and for this reason preference should be given to those scraps that carry a high protein content and are free from an excessive amount of bone.

The *Rarva Meat Meal*, which is a by-product of meat extract, is worthy of particular mention.

Meat-and-bone meal and bone meal, particularly the cracked, unrendered bone, are preferred by some feeders to meat scraps. While they do not furnish as much meat or protein, they contain mineral matter, phosphates, etc., that are of value for growing fowls. As sources of protein alone, they cannot be considered as economical as meat scraps.

Blood meal which has been especially prepared for the purpose is occasionally offered as a poultry feed. There is no reason why it should not prove a satisfactory source of animal food when used in limited amounts in poultry mashes.

Fish meal, which may be the waste from the manufacture of fish glue, the trimmings from the preparation of cured fish for market, or the so-called fish pomace (derived from the menhaden after the extraction of the oil), is quite extensively used as a poultry food. Such material should be substantially free from salt, otherwise it is likely to act injuriously on poultry and particularly on young chickens.

The material known as *milk albumen* is a by-product in the manufacture of milk sugar. Its name is misleading for, while

it contains considerable albumen, it is also particularly rich in ashy matter. It is doubtful if it has a greater feeding value than a good quality of meat scraps.

Alfalfa Meals. Page 42. The alfalfa meals collected sold at an average retail price of about $34 a ton. They vary considerably in value, some containing decidedly more fiber and less protein than others. Alfalfa meal cannot be considered economical for poultry as a source of nutriment. It is generally used, however, as a substitute for green feed during the winter season. It is believed that the poultryman can secure his own green feed cheaper by providing himself, during the summer season, with dry lawn clippings, early-cut green clover or alfalfa, waste cabbage and mangels. In case alfalfa meal is purchased, preference should always be given to the brands containing 14 or more per cent of protein and not over 30 per cent of fiber. Home-grown alfalfa is, as a rule, preferable to the baled or ground alfalfa shipped from the West.

Poultry Mashes and Meals. Pages 43-46. Judging from the wide variations in chemical analysis and in the ingredients used, it can be safely assumed that there is no definite idea of what would constitute a satisfactory poultry mash. In proof of this, note the analyses and statements of ingredients given on pages 43-46 of this bulletin. It certainly would prove economical for the large consumer to purchase the individual feeding stuffs that he considers necessary to give the best results and to mix the mash at home rather than to depend upon the ready-to-use mashes for which he must pay a price considerably in advance of that asked for their several components.

MARKET PRICES OF COMMERCIAL FEED STUFFS FOR 1912-1913.

FEED STUFFS.	Average Monthly Wholesale Ton Prices—1912-1913.												Average.
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	
Cottonseed Meal	$30.09	$29.92	$30.44	$32.50	$31.75	$31.10	$31.00	$31.85	$32.85	$32.88	$31.09	$32.38	$31.49
Linseed Meal (N. P. and O. P.)	35.17	34.67	35.00	32.00	31.67	30.50	28.63	27.80	28.38	28.94	28.90	30.88	31.05
Gluten Feed (sacked)	28.75	27.17	27.30	29.90	30.23	29.65	25.90	25.02	25.10	25.60	26.60	28.85	27.51
Gluten Feed (bulk)	27.50	25.58	25.55	26.74	28.43	27.69	24.05	23.49	23.65	24.65	25.15	26.95	25.79
Distillers' Dried Grains	32.50	31.75	30.63	—	31.25	31.50	29.75	28.00	—	28.50	30.00	32.50	30.64
Malt Sprouts	—	—	—	—	—	22.33	21.13	19.50	—	—	—	—	20.99
Flour Middlings (Red Dog)	32.94	33.00	30.69	29.00	29.33	29.19	28.75	27.85	28.13	28.88	29.07	30.06	29.74
Standard Middlings (shorts)	29.35	27.71	25.71	26.25	26.04	25.63	24.29	23.54	24.32	25.01	25.20	27.41	25.87
Mixed Feed	28.22	27.50	26.57	26.38	26.38	25.91	24.94	24.15	24.38	24.97	24.73	26.88	25.92
Bran, Spring	24.19	23.75	23.13	24.50	24.33	22.94	22.04	21.20	21.38	21.81	21.70	24.63	22.97
Bran, Winter	24.88	24.34	23.56	25.00	24.83	23.75	22.91	21.45	21.69	22.13	22.43	24.94	23.49
Hominy Meal (sacked)	31.79	29.43	26.43	25.96	24.93	24.15	22.21	23.85	24.36	24.68	25.69	29.05	26.04
Hominy Meal (bulk)	30.17	27.54	24.70	23.90	23.48	22.40	20.65	22.55	22.82	23.79	24.06	27.54	24.47
Corn Meal	34.55	31.40	27.20	24.80	23.40	23.20	22.90	24.60	25.30	26.50	27.60	31.40	26.90
Corn, No. 2, yellow	32.64	28.04	25.11	—	—	22.15	21.57	23.39	24.04	25.36	26.25	29.79	25.83
Oats, No. 2, clipped white	26.19	25.94	24.56	25.63	25.63	25.38	25.00	25.63	27.81	29.75	30.00	31.19	26.89
Rye, No. 2	28.39	28.39	27.02	24.46	25.23	26.52	25.89	24.29	26.00	25.71	25.36	25.50	26.06
Feed Barley	26.04	26.33	26.15	23.96	25.00	25.42	23.96	23.75	24.44	26.04	25.83	27.42	25.36
Hay, No. 1, large bales	23.13	22.25	22.38	21.75	20.84	20.44	20.38	21.60	21.38	20.53	20.70	21.19	21.38
Hay, No. 2, large bales	20.87	20.47	20.07	20.25	18.67	17.94	17.44	19.00	18.75	17.92	18.40	19.19	19.08
Hay, No. 1, clover mixed	17.07	17.67	18.13	18.50	17.83	17.25	17.25	17.14	16.25	16.00	15.50	16.44	17.09
Straw, choice rye	16.82	17.34	17.88	17.00	17.75	19.51	19.29	21.68	24.92	25.28	20.24	17.92	19.64
Straw, oat	8.61	10.50	11.00	11.50	12.00	12.19	11.17	10.85	12.07	12.32	11.00	10.44	11.14

BULLETIN No. 147. DECEMBER 1913.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

INSPECTION OF Commercial Fertilizers

—BY—

H. D. HASKINS, L. S. WALKER, C. P. JONES and W. S. FROST

This bulletin gives a detailed report of the fertilizer inspection for 1913. It states the number of fertilizers inspected, gives trade values of fertilizer ingredients, provides a summary showing average composition of unmixed fertilizing material as well as pound cost of each element of plant food furnished. Special attention is called to commercial shortages existing in both unmixed fertilizing materials and mixed goods. Particular emphasis is laid upon the economy of purchasing only high grade fertilizers. A summary table shows the general standing of each manufacturer's brands. A discussion is made of the quality of plant food found present in the mixed goods. A summary table shows the general quality of nitrogen found in each manufacturer's product. A brief statement of a field experiment is given to show the actual crop producing power of the "New Mineral Fertilizer" and other stonemeal products. Mention is made of the number and nature of the lime products analyzed. Tables of analyses give the detailed composition of all fertilizers and lime products sold in the state. Commercial valuations of the plant food in all fertilizing materials, calculated from the table of trade values, are published, and for the lime compounds, the actual cost of 100 pounds of calcium and magnesium oxides is given in each case.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

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Annual reports and bulletins are sent free on request to all parties interested in agriculture. Correspondence or consultation on all matters affecting any branch of experiment station work is welcomed. Communications should be addressed to the

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

*On leave.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, *Chemist.*

INSPECTION OF COMMERCIAL FERTILIZERS

FOR THE SEASON OF 1913.

By H. D. Haskins, *Chemist in Charge,*
Assisted by
L. S. Walker, C. P. Jones and W. S. Frost.

The full text of the new fertilizer law, Chapter 388, 1911, was published in Fertilizer Bulletin No. 140, December, 1911. The essential features of this law were also enumerated in Fertilizer Bulletin No. 143, December 1912. A full copy of the law may be had at any time by addressing the Massachusetts Agricultural Experiment Station.

Manufacturers and Brands. One hundred manufacturers, importers and dealers, including the various branches of the large corporations, have secured certificates for the sale of 541 different brands of fertilizer, agricultural chemicals, raw products and agricultural limes in the Massachusetts markets during the season of 1913. They may be classed as follows:

Complete fertilizers	346
Fertilizers furnishing phosphoric acid and potash	9
Ground bone, tankage and dry ground fish	58
Chemicals and organic nitrogen compounds	101
Agricultural limes	27
	541

Alphabetical list of those who have registered fertilizers and lime for sale in Massachusetts during 1913, together with brands registered by each.

W. H. Abbott, Holyoke, Mass.

Abbott's Animal Fertilizer,
Abbott's Eagle Brand Fertilizer,
Abbott's Onion Brand,
Abbott's Tobacco Fertilizer.

Alphano Humus Co., Whitehall Bldg., New York City.

Prepared Alphano Humus.

The American Agricultural Chemical Co., 92 State St., Boston, Mass.

Bradley's Complete Manure for Corn and Grain,
Bradley's Complete Manure for Potatoes and Vegetables,
Bradley's Complete Manure for Top Dressing Grass and Grain,
Bradley's Complete Manure with 10% Potash,

Bradley's Corn Phosphate,
Bradley's Eclipse Phosphate for All Crops,
Bradley's English Lawn Fertilizer,
Bradley's Green Mountain Special,
Bradley's High Grade Fertilizer with 10% Potash,
Bradley's High Grade Potato and Root Special,
Bradley's Niagara Phosphate,
Bradley's Potato Fertilizer,
Bradley's Potato Manure,
Bradley's XL Superphosphate of Lime,
Clark's Cove Bay State Fertilizer,
Clark's Cove Bay State Fertilizer, G. G.
Clark's Cove Great Planet Manure, A. A.
Clark's Cove Potato Fertilizer,
Clark's Cove Potato Manure,
Darling's Blood, Bone and Potash,
Darling's Complete 10% Manure,
Darling's Farm Favorite,
Darling's General Fertilizer,
Darling's Potato Manure,
Darling's Potato and Root Crop Manure,
East India A. A. Ammoniated Superphosphate,
Farquhar's Lawn and Garden Dressing,
Farquhar's Pure Ground Bone,
Farquhar's Vegetable and Potato Fertilizer,
Great Eastern Garden Special,
Great Eastern General Fertilizer,
Great Eastern Northern Corn Special,
Great Eastern Vegetable, Vine, and Tobacco,
Pacific High Grade General Fertilizer,
Pacific Potato Special,
Soluble Pacific Guano,
Packer's Union Animal Corn Fertilizer,
Packer's Union Gardener's Complete Manure,
Packer's Union Potato Manure,
Packer's Union Universal Fertilizer,
Quinnipiac Corn Manure,
Quinnipiac Market Garden Manure,
Quinnipiac Phosphate,
Quinnipiac Potato Manure,
Quinnipiac Potato Phosphate,
Read's Farmer's Friend Superphosphate,
Read's High Grade Farmer's Friend Superphosphate,
Read's Practical Potato Special Fertilizer,
Read's Standard Superphosphate,
Read's Vegetable and Vine Fertilizer,
Standard Complete Manure,
Standard Fertilizer,
Standard Guano for All Crops,
Standard Special for Potatoes,
Wheeler's Connecticut Tobacco Grower,
Wheeler's Corn Fertilizer,
Wheeler's Havana Tobacco Grower,
Wheeler's Potato Manure,
Williams and Clark's Americus Ammoniated Bone Superphosphate,
Williams & Clark's Americus Corn Phosphate,
Williams & Clark's Americus High Grade Special for Potatoes and Vegetables,
Williams & Clark's Americus Potato Manure,
Williams & Clark's Potato Phosphate,
Williams & Clark's Prolific Crop Producer,
Williams & Clark's Royal Bone Phosphate for all Crops,
Church's Fish and Potash "D",
Complete Tobacco Manure,
First Year Top Dressing,
Grass and Lawn Top Dressing,
Grass and Oats Fertilizer,
High Grade Fertilizer with 10% Potash,
Northwestern Empire Special Manure,
Special Grass and Garden Mixture,
Tobacco Starter and Grower,
Dissolved Bone Black,
Double Manure Salt,
Dry Ground Fish,
Fine Ground Bone,
Fine Ground Nova Scotia Plaster,
Genuine German Kainit,
Ground Tankage (4.94% Nitrogen),
Ground Tankage (7.41% Nitrogen),
High Grade Dried Blood,
High Grade Sulphate of Potash,
Muriate of Potash,
Nitrate of Soda,
Plain Superphosphate 12%,
Plain Superphosphate 14%,
Sulphate of Ammonia,
Thomas Phosphate Powder, (Basic Slag).

American Cotton Oil Co., 27 Beaver St., New York City.

Choice Cottonseed Meal,

Prime Cottonseed Meal,

Armour Fertilizer Works, 930 Equitable Bldg., Baltimore, Maryland.

All Soluble,
Ammoniated Bone with Potash,
Bone, Blood and Potash,
Bone Meal,
Complete Potato,
Connecticut Valley Tobacco Grower,
Fish and Potash,
Fruit and Root Crop Special,
Grain Grower,
High Grade Potato,
Market Garden Fertilizer,
Muriate of Potash,
Nitrate of Soda,
Onion Special,
Special Value,
Star Phosphate.

Atlantic Fertilizer Co., Stock Exchange Bldg., Baltimore, Md.

Garden Fertilizer,
Potato Fertilizer.

Beach Soap Co., Lawrence, Mass.

Beach's Advance Brand,
Beach's Fertilizer Bone,
Beach's Lawn Dressing,
Beach's Market Garden,
Beach's Reliance Brand,
Beach's Seeding Down Brand,
Beach's TopDressing.

Berkshire Fertilizer Co., Bridgeport, Ct.

Berkshire Ammoniated Bone Phosphate,
Berkshire Complete Fertilizer,
Berkshire Complete Tobacco Fertilizer,
Berkshire Cowl's Special Brand,
Berkshire Economical Grass Fertilizer,
Berkshire Fish and Potash,
Berkshire Grass Special,
Berkshire Long Island Special,
Berkshire Long Island Special, 4-8-7,
Berkshire Potato and Vegetable Phosphate,
Berkshire Tobacco Special with Carbonate of Potash,
Berkshire Acid Phosphate,
Berkshire Double Sulfate of Potash,
Berkshire Dry Ground Fish,
Berkshire Muriate of Potash,
Berkshire Nitrate of Soda,
Berkshire Sulfate of Potash,
Berkshire Tankage.

Berkshire Hills Co., Sheffield, Mass.

Agricultural Lime.

E. E. Bisbee, 147 Pearl St., Boston, Mass.

Basic Slag Phosphate.

Chas. M. Bolles, East Pepperell, Mass.

Nissitissitt Plant Food.

Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.

Bowker's Ammoniated Food for Flowers,
Bowker's Blood, Bone and Potash,
Bowker's Bone and Wood Ash Fertilizer,
Bowker's Complete Alkaline Tobacco Grower (Potash from Sulphate),
Bowker's Corn Phosphate,
Bowker's Early Potato Manure,
Bowker's Farm and Garden Phosphate,
Bowker's Fish and Potash, Square Brand,
Bowker's Gloucester Fish and Potash,
Bowker's Grain and Grass Fertilizer,
Bowker's High Grade Fertilizer,
Bowker's Highly Nitrogenized Mixture,
Bowker's Hill and Drill Phosphate,
Bowker's Lawn and Garden Dressing,
Bowker's Market Garden Fertilizer,
Bowker's Onion Fertilizer (Potash from Sulphate),
Bowker's Potato and Vegetable Fertilizer,
Bowker's Potato and Vegetable Phosphate,
Bowker's Pulverized Sheep Manure,
Bowker's Soluble Animal Fertilizer,
Bowker's Sure Crop Phosphate,
Bowker's Tobacco Ash Elements, (Potash from Sulfate),
Stockbridge Special Complete Manure for Corn and all Grain Crops,
Stockbridge Special Complete Manure for Potatoes and Vegetables,
Stockbridge Special Complete Manure for Seeding Down, Permanent Dressing and Legumes, (Potash from Sulfate),
Stockbridge Special Complete Manure for Top Dressing and Forcing,

Stockbridge Tobacco Manure, (Potash from Sulfate).
Bowker's Acid Phosphate,
Bowker's Dissolved Bone,
Bowker's Dissolved Bone Black,
Bowker's Double Manure Salt,
Bowker's Dried Blood,
Bowker's Dry Ground Fish,
Bowker's Fine Ground Bone Tankage,
Bowker's Fresh Ground Bone,
Bowker's Genuine German Kainit,
Bowker's High Grade Sulfate of Potash,
Bowker's Muriate of Potash,
Bowker's Nova Scotia Land Plaster,
Bowker's Nitrate of Soda,
Bowker's Pure Unleached Canada Hardwood Ashes,
Bowker's Sulfate of Ammonia,
Bowker's Thomas Phosphate Powder, ("Basic Slag").

Joseph Breck & Sons Corporation, 51-52 North Market St., Boston, Mass.

Breck's High Grade Wood Ashes,
Breck's Lawn and Garden Dressing,
Breck's Market Garden Manure,
Breck's Ram's Head Brand Sheep Manure.

F. W. Brode & Co., 40 S. Front St., Memphis, Tenn.

Owl Brand Cottonseed Meal.

The Buckeye Cotton Oil Co., Cincinnati, Ohio.

"Buckeye" Cottonseed Meal.

Cheshire Lime Manufacturing Co., Cheshire, Mass.

Cheshire Agricultural Lime.

The E. D. Chittenden Co., Bridgeport, Ct.

Chittenden's Complete Tobacco Grower,
Chittenden's Complete Tobacco and Onion Grower,
Chittenden's Dry Ground Fish,
Chittenden's Fish and Potash Special Formula,
Chittenden's Grain and Vegetable,
Chittenden's Grass and Grain,
Chittenden's Ground Bone,
Chittenden's Potato and Grain,
Chittenden's Tobacco Special.

Clay & Sons, Stratford, London, England.

Clay's Fertilizer.

The Coe-Mortimer Co., 51 Chambers St., New York City.

E. Frank Coe's Blood, Bone, and Potash,
E. Frank Coe's Celebrated Special Potato Fertilizer,
E. Frank Coe's Columbian Corn and Potato Fertilizer,
E. Frank Coe's Complete Manure with 10% Potash,
E. Frank Coe's Double Strength Potato Manure,
E. Frank Coe's Double Strength Top Dressing,
E. Frank Coe's Excelsior Potato Fertilizer,
E. Frank Coe's Famous Prize Brand Grain and Grass Fertilizer,
E. Frank Coe's Gold Brand Excelsior Guano,
E. Frank Coe's High Grade Ammoniated Superphosphate,
E. Frank Coe's New Englander Corn and Potato Fertilizer,
Peruvian Grass Top Dressing,
Peruvian Market Gardener's Fertilizer,
Peruvian Tobacco Fertilizer (For Wrapper Leaf),
Peruvian Vegetable Grower,
E. Frank Coe's Red Brand Excelsior Guano (For Market Gardening),
E. Frank Coe's Special Grass Top Dressing,
E. Frank Coe's Standard Potato Fertilizer,
E. Frank Coe's XXV Ammoniated Phosphate,
E. Frank Coe's Ground Tankage (4.91% Nitrogen),
E. Frank Coe's Ground Tankage (9-20 Grade),
E. Frank Coe's High Grade Soluble Phosphate,
E. Frank Coe's High Grade Dried Blood,
E. Frank Coe's Muriate of Potash,
E. Frank Coe's Nitrate of Soda,
E. Frank Coe's Sulfate of Potash,
E. Frank Coe's Thomas Phosphate Powder (Basic Slag Phosphate),
E. Frank Coe's 12% Superphosphate,
E. Frank Coe's XXX Fine Ground Bone.

F. E. Conley Stone Co., Utica, N. Y.
Raw Ground Lime.

Dexter Lime Rock Co., Lime Rock, Rhode Island.
Ground Limestone,
Slaked Lime.

John C. Dow Company, 13-14 Chatham St., Boston, Mass.
Dow's Pure Ground Bone.

The Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.
IMP Plant Food.

The Edison Portland Cement Co., Stewartsville, N. J.
Edison Pulverized Limestone.

R. & J. Farquhar & Co., Boston, Mass.
Pulverized Sheep Manure.

Essex Fertilizer Co., 39 North Market St., Boston, Mass.
Essex A1 Superphosphate,
Essex Complete Manure for Corn, Grain and Grass,
Essex Complete Manure for Potatoes, Roots and Vegetables,
Essex Grain, Grass and Potato Fertilizer,
Essex Grass and Top Dressing for Lawns and Meadows,
Essex Ground Bone,
Essex Lawn Dressing,
Essex Market Garden and Potato Manure,
Essex Nitrate of Soda,
Essex Peerless Potato Manure.
Essex Special Potato Phosphate for Potatoes and Roots,
Essex Tobacco Starter and Grower,
XXX Fish and Potash for All Crops.

Farnam Cheshire Lime Co., Farnams, Mass.
Specially Prepared Agricultural Lime.

German Kali Works, New York City.
Kainit,
Muriate of Potash,
Sulfate of Potash.

Green Mountain Lime Co., Middlebury, Vt.
Agricultural Lime.

Chas. W. Hastings, Dorchester, Mass.
Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.
Pure Bone Meal,
Meat and Bone.

A. W. Higgins, Westfield, Mass.
Cottonseed Meal,
Calcium Cyanamide.

Home Soap Co., Worcester, Mass.
Pure Ground Bone.

Hoosac Valley Lime and Marble Co., Adams, Mass.
Adams Agricultural Lime,
Adams Lime Ashes.

Humphreys-Godwin Co., Memphis, Tenn.
Dixie Brand Cottonseed Meal,
High Grade Cottonseed Meal (7.75% Nitrogen).

Imperial Cotto Milling Co., Chicago, Ill.
Imperial Cotto Brand Choice Cottonseed Meal.

International Agricultural Corporation, Buffalo Fertilizer Works, Branch, Buffalo, N. Y.
Buffalo Celery and Potato Special,
Buffalo Farmer's Choice,
Buffalo Fish Guano,
Buffalo High Grade Manure,
Buffalo New England Special,
Buffalo Onion Formula,
Buffalo Tobacco Producer,
Buffalo Top Dresser,
Buffalo Vegetable and Potato,
Buffalo Acid Phosphate,
Buffalo Bone Meal,
Buffalo Dissolved Phosphate,
Buffalo Dried Blood,
Buffalo Dry Ground Fish,
Buffalo Muriate of Potash,
Buffalo Nitrate of Soda,
Buffalo Sulfate of Ammonia,
Buffalo Sulfate of Potash.

Johnson Seed Potato Co., Leominster, Mass.
Ideal Potato Manure (Planting Brand),
Ideal Potato Manure (Hoeing Brand).

John Joynt, Lucknow, Ontario, Canada.

Canada Unleached Hardwood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.

Lister's Celebrated [illegible] Fertilizer.
Lister's Complete Tobacco Manure.
Lister's [illegible] and Grass Fertilizer.
Lister's High Grade Special for Spring Crops.
Lister's Potato Manure.
Lister's Special Corn Fertilizer.
Lister's Special Potato Fertilizer.
Lister's Special Tobacco Fertilizer.
Lister's Standard Grass Fertilizer.
Lister's Success Fertilizer.
Lister's [illegible] Potato Grower.
Lister's Fish Scrap.
Lister's Ground Nova Scotia Land Plaster.
Lister's Nitrate of Soda.

Lowell Fertilizer Co., 40 North Market St., Boston, Mass.

Lowell Animal Brand, Complete for All Crops.
Lowell Bone Fertilizer for Corn, Grain, Grass and Vegetables.
Lowell Corn and Vegetable [illegible]
Lowell Dissolved Bone and Potash.
Lowell Empress Brand for Corn, Potatoes and Grain.
[illegible]
Lowell Dried Blood.
Lowell Ground Bone.
Lowell Muriate of Potash.
Lowell Nitrate of Soda.
Lowell Sulfate of Potash.
Lowell Tankage.

James E. McGovern, Andover, Mass.

Andover Animal Fertilizer.

Manufacturer's Wool Stock Co., Millbury, Mass.

Merino Brand Sheep Manure.

Mapes Formula and Peruvian Guano Co., 143 Liberty St., New York City.

Mapes' Average Soil Complete Manure.
Mapes' Cauliflower and Cabbage Manure.
Mapes' Cereal Brand.
Mapes' Complete Manure for General Use.
Mapes' Complete Manure 10% Potash.
Mapes' Corn Manure.
Mapes' Dissolved Bone.
Mapes' Economical Potato Manure.
Mapes' Fruit and Vine Manure.
Mapes' Grass and Grain Spring Top Dressing.
Mapes' Lawn Dressing.
Mapes' Potato Manure.
Mapes' Tobacco Ash Constituents.
Mapes' Tobacco Manure, Wrapper Brand.
Mapes' Tobacco Starter, Improved.
Mapes' Top Dresser, Improved, Full Strength.
Mapes' Top Dresser, Improved, Half Strength.
Mapes' Vegetable or Complete Manure for Light Soils.

Marl Products Company, Barton, Vt.

Agricultural Marl.

George E. Marsh Company, Lynn, Mass.

Marsh's Fine Ground Tankage.
Marsh's Pure Ground Bone.

W. L. Mitchell, New Haven, Ct.

Lime Kiln Ashes.

Geo. L. Munroe & Sons, Oswego, N. Y.

Pure Unleached Wood Ashes.

D. M. Moulton, Monson, Mass.

Ground Bone.

National Fertilizer Co., 92 State St., Boston, Mass.

Chittenden's Ammoniated Bone Phosphate.

Chittenden's Complete Grass Fertilizer.
Chittenden's Complete Root and Grain Fertilizer.
Chittenden's Complete Tobacco Fertilizer (Sulfate).
Chittenden's Connecticut Valley Tobacco Grower (Carbonate).
Chittenden's Connecticut Valley Tobacco Starter (Sulfate).
Chittenden's Eureka Potato Fertilizer.
Chittenden's Fish and Potash.
Chittenden's High Grade Top Dressing.
Chittenden's High Grade Special Tobacco Fertilizer (Sulfate).
Chittenden's Market Garden Fertilizer.
Chittenden's Potato Phosphate.
Chittenden's Tobacco Special with Carbonate Potash.
Chittenden's Tobacco Special with Sulfate Potash.
Chittenden's N.N.N. Fish and Potash.
Chittenden's Dry Ground Fish.
Chittenden's Fine Ground Bone.
Chittenden's Plain Superphosphate 16%.
Chittenden's Plain Superphosphate. 14%.

Natural Guano Co., Aurora, Ill.

Sheep's Head Pulverized Sheep Manure.

New England Fertilizer Co., 40A N. Market Street., Boston, Mass.

New England Complete Manure with 10% Potash.
New England Corn and Grain Fertilizer.
New England Corn Phosphate.
New England High Grade Potato.
New England High Grade Special with 10% Potash.
New England Perfect Tobacco Grower.
New England Potato Fertilizer.
New England Superphosphate for All Crops.

New England Lime Co., Danbury, Ct.

Adams (Mass.) Agricultural Lime.
Adams (Mass.) Fresh Burned Granulated Lime.
Adams (Mass.) Lime Ashes.
Canaan (Conn.) Lime Ashes.
Connecticut Agricultural Lime.

New Mineral Fertilizer Co., Boston, Mass.

The New Mineral Fertilizer.

Nitrate Agencies Co., 25 Bridge St., New York City.

Acid Phosphate.
Basic Slag Phosphate.
Dried Blood.
Ground Bone.
Ground Tankage.
High Grade Acid Phosphate, 16%.
Kainit.
Muriate of Potash.
Nitrate of Soda.
Sulfate of Ammonia.
Sulfate of Potash.

W. C. Nothern, Little Rock, Ark.

Bee Brand Cottonseed Meal.

Olds & Whipple, Hartford, Ct.

Olds & Whipple's Complete Grass Fertilizer.
Olds & Whipple's Complete Corn and Potato.
Olds & Whipple's Complete Onion Fertilizer.
Olds & Whipple's Complete Tobacco Fertilizer.
Olds & Whipple's Fish and Potash.
Olds & Whipple's High Grade Potato Fertilizer.
Olds & Whipple's Potash and Bone Phosphate.
Olds & Whipple's Special Onion Fertilizer.
Olds & Whipple's Agricultural Lime.
Olds & Whipple's Bone Meal.
Olds & Whipple's Castor Pomace.
Olds & Whipple's Cottonseed Meal.
Olds & Whipple's Double Manure Salts.
Olds & Whipple's Dry Ground Fish.
Olds & Whipples' Nitrate of Soda.
Olds & Whipple's Sulfate of Potash.

The Pan American Fertilizer Co., New York City.

Pan American Market Garden Standard.

Parmenter & Polsey Fertilizer Co., 40 N. Market St., Boston, Mass.

Parmenter & Polsey A. A. Brand.
Parmenter & Polsey Aroostook Special with 10% Potash.

Parmenter & Polsey Maine Potato Fertilizer with 10% Potash,
Parmenter & Polsey Plymouth Rock Brand for All Crops,
Parmenter & Polsey Potato Fertilizer,
Parmenter & Polsey Potato Grower with 10% Potash,
Parmenter & Polsey Special Potato Fertilizer for Potatoes and Root Crops,
Parmenter & Polsey Star Brand Superphosphate.

R. T. Prentiss, Granby, Mass.

R. T. Prentiss Complete for Corn,
R. T. Prentiss Complete for Potatoes,
R. T. Prentiss Complete Top Dressing.

Pulverized Manure Co., Chicago, Ill.

Wizard Brand Sheep Manure,
Wizard Brand Cattle Manure.

Rockland & Rockport Lime Co., Rockland, Me.

R. R. Land Lime.

The Rogers Manufacturing Co., Rockfall, Ct.

All Round Fertilizer,
Complete Potato and Vegetable,
Dry Ground Fish,
Fish and Potash,
High Grade Corn and Onion,
High Grade Grass and Grain,
High Grade Oats and Top Dressing,
High Grade Soluble Tobacco,
High Grade Tobacco and Potato,
High Grade Tobacco Grower,
New High Grade Tobacco Grower (Vegetable and Carbonate Formula),
Pure Fine Ground Bone,
Pure Knuckle Bone Flour.

The Rogers & Hubbard Co., Middletown, Ct.

Hubbard's "Bone Base" All Soils-All Crops Phosphate,
Hubbard's "Bone Base" Complete Phosphate,
Hubbard's "Bone Base" Fertilizer for Seeding Down and Fruit (Formerly called Grass and Grain),
Hubbard's "Bone Base" New Market Garden Phosphate,
Hubbard's "Bone Base" Oats and Top Dressing,
Hubbard's "Bone Base" Potato Phosphate,
Hubbard's "Bone Base" Pure Raw Knuckle Bone Flour,
Hubbard's "Bone Base" Soluble Corn & General Crops,
Hubbard's "Bone Base" Strictly Pure Bone,
Hubbard's "Bone Base" Soluble Tobacco Manure,
Hubbard's "Bone Base" Soluble Potato Manure,
Hubbard's Tobacco Special.

Ross Brothers Co., 88 Front St., Worcester, Mass.

Corn, Grass and Grain,
High Grade Potato and Vegetables,
Potato and Vegetable,
Worcester Lawn Dressing,
Basic Slag Phosphate,
Double Sulfate of Potash and Magnesia.

F. S. Royster Guano Co., Baltimore, Maryland.

Royster's Champion Crop Compound,
Royster's Gold Seal Potato Special,
Royster's Harvest King Fertilizer,
Royster's High Grade Corn Fertilizer,
Royster's High Grade Tobacco Manure,
Royster's High Grade Top Dresser,
Royster's Practical Truck Grower,
Royster's Royal Special Potato Guano,
Royster's Special Celery and Onion Guano,
Royster's Universal Truck Grower.

J. W. Sanborn, Pittsfield, N. H.

Prof. Sanborn's Chemical Fertilizer for Grass and Grain,
Prof. Sanborn's Chemical Fertilizer for Hill and Drilll,
Prof. Sanborn's Chemical Fertilizer for Potatoes and Corn.

Sanderson Fertilizer & Chemical Co., New Haven, Ct.

Sanderson's Atlantic Coast Bone, Fish and Potash,
Sanderson's Complete Tobacco Grower,
Sanderson's Corn Superphosphate,
Sanderson's Formula A,
Sanderson's Formula B,
Sanderson's Potato Manure,
Sanderson's Special with 10% Potash,

Sanderson's Top Dressing for Grass and Grain,
Sanderson's Fine Ground Fish,
Sanderson's High Grade Sulfate of Potash,
Sanderson's Muriate of Potash,
Sanderson's Nitrate of Soda,
Sanderson's Plain Superphosphate,
Sanderson's Thomas Phoshate Powder.

M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.

"Swift-Sure" Bone Meal,
"Swift-Sure" Superphosphate for General Use.

A. M. Smith & Co., Boston, Mass.

Equity Brand Dry Ground Hen Manure.

J. E. Soper Co., 206 Chamber of Commerce, Boston, Mass.

Pioneer Cottonseed Meal,
Pilgrim Cottonseed Meal.

Springfield Rendering Co., Springfield, Mass.

Ground Steamed Bone,
Tankage.

Thomas L. Stetson, Randolph, Mass.

Pure Ground Bone.

The Stearns Lime Co., Danbury, Ct.

Ground Limestone for Soil Improvement.

Wm. Thomson & Sons, Ltd., Clovenfords, Scotland.

Thomson's Vine, Plant & Vegetable Manure,
Thomson's Special Top Dressing & Chrysanthemum Manure.

The Tobey Lime Co., West Stockbridge Mass.

Tobey Brand Agricultural Lime.

20th Century Specialty Co., Boston, Mass.

"Scientific" 12 L. No. 1,
"Scientific" 12 L. No. 2,
"Scientific" 12 L. No. 3.

Vermont Marl Co., Brattleboro, Vt.

Shell-Marl Land-Lime.

Charles Warner Co., Wilmington, Del.

Limoid, (Hydrated Lime).

West Stockbridge Lime Co., West Stockbridge, Mass.

Agricultural Lime.

Whitingham Lime Co., Greenfield, Mass.

Green Mountain Agricultural Lime.

Whitman & Pratt Rendering Co., Lowell, Mass.

Whitman & Pratt's All Crop,
Whitman & Pratt's Corn Success Fertilizer,
Whitman & Pratt's Potash Special,
Whitman & Pratt's Potato Manure,
Whitman & Pratt's Vegetable Grower,
Whitman & Pratt's Acid Phosphate,
Whitman & Pratt's Basic Slag Phosphate,
Whitman & Pratt's Muriate of Potash,
Whitman & Pratt's Nitrate of Soda,
Whitman & Pratt's Pure Ground Bone,
Whitman & Pratt's Sulfate of Potash,
Whitman & Pratt's Tankage.

Wilcox Fertilizer Co., Mystic, Ct.

Wilcox Complete Bone Superphosphate,
Wilcox Corn Special,
Wilcox Fish and potash,
Wilcox 4-8-10 Fertilizer,
Wilcox Grass Fertilizer,
Wilcox High Grade Fish and Potash,
Wilcox High Grade Tobacco Special,
Wilcox Potato Fertilizer,
Wilcox Potato, Onion & Vegetable Phosphate,
Wilcox Special Superphosphate,
Wilcox Acid Phosphate,
Wilcox Basic Slag Meal,
Wilcox Dry Ground Acidulated Fish,
Wilcox Dry Ground Fish Guano,
Wilcox High Grade Sulfate of Potash,
Wilcox High Grade Tankage,
Wilcox Kainit,
Wilcox Muriate of Potash,
Wilcox Nitrate of Soda,
Wilcox Pure Ground Bone.

S. Winter Co., Brockton, Mass.

Pure Ground Bone.

A. H. Wood & Co., Framingham, Mass.

Wood's B. B. Fertilizer,

Wood's S. P. Fertilizer.
Wood's 7-7-7 Fertilizer.

J. M. Woodard, Greenfield, Mass.
Woodard's Unground Tankage.

Worcester Rendering Co, Auburn, Mass.
Ground Tankage.

Collection of Fertilizers. The fertilizer collection was made by our regular inspector, Mr. James T. Howard, assisted by Messrs. R. G. Smith and L. O. Stevenson. With few exceptions, a representative sample was procured of every brand of fertilizer registered for sale in Massachusetts. The usual custom of procuring samples of the same brand in various parts of the state has been followed, the object being to sample as large a tonnage as possible, so as to make the analysis more representative. Data collected by our inspectors show that 6,465 tons of fertilizer were sampled. This necessitated the drawing of fertilizer from over 17,000 sacks; 69.3 per cent of the total tonnage of complete fertilizers sampled were high grade, (valued over $24. per ton), 20.6 per cent were medium grade, (valued between $18.00 and $24.00 per ton), and only 10 per cent were low grade, (valued less than $18.00 per ton). It is gratifying to note the large tonnage of high and medium grade fertilizers as compared with the low grade goods.

Nearly all of the cottonseed meal used as fertilizer for tobacco is bought on a guarantee of nitrogen, subject to an analysis by the Experiment Station, proper rebates being allowed in case of nitrogen shortage. The same custom holds true in the purchase of many chemicals and lime compounds. It has been the custom to sample and analyze these large shipments of meal, fertilizer and lime, upon application, a representative sample being thereby assured. The sampling usually takes place before the regular inspection and a part of the expense is borne by the purchaser. This method reduces the number of samples sent to the station, so that the actual work involved in the separate analysis of these products is but little more, aside from the drawing of the samples, than would be the case if the samples were taken and sent by the purchaser.

The present season 133 towns were visited and 1,299 samples, representing 571 brands, were drawn from stock found in the possession of 381 different agents. This is 119 more samples, representing 44 more brands, than were taken during the previous year.

Fertilizers Analyzed. Seven hundred and forty-seven analyses, (573 distinct brands), have been made during the year's inspection. They may be grouped as follows:

Complete Fertilizers	427
Materials furnishing phosphoric acid and potash	26
Ground bone, tankage and fish	67

Nitrogen compounds	95
Potash compounds	45
Phosphoric acid compounds	47
Lime compounds	40
	747

Trade Values of Fertilizing Ingredients. The following table of trade values was adopted at a meeting of representatives of the Experiment Stations of New England, New York and New Jersey, held during the first week of March, 1913; this schedule has served as a basis for valuing the fertilizers and fertilizing materials here reported.

These values represent the average cost per pound at retail for the six months preceding March 1st, of nitrogen, potash and phosphoric acid as furnished by high grade chemicals and standard unmixed fertilizing material in large markets in New York and New England. The values represent the average wholesale quotations of chemicals and raw products as published in the trade journals from Sept. 1, 1912 to March 1, 1913, plus about 20 per cent.

	Cents per pound.	
Nitrogen.	1912.	1913.
In ammonia salts	16.5	18.5
In nitrates	16.5	18.5
Organic nitrogen in dry and fine ground fish, blood and meat	22	20
Organic nitrogen in fine* bone, tankage and mixed fertilizers	19	19
Organic nitrogen in coarse* bone and tankage	15	15
Organic nitrogen in cottonseed meal, castor pomace, linseed meal, etc	20	20
Phosphoric Acid.		
Soluble in water	4.5	4.5
Soluble in neutral ammonium citrate solution (reverted phosphoric acid)**	4	4
In fine* ground bone and tankage	4	4
In coarse* bone, tankage and ashes	3.5	3.5
In cottonseed meal, castor pomace and linseed meal	4	4
Insoluble (in neutral ammonium citrate solution) in mixed fertilizers	2	2

*Fine bone and tankage are separated from coarse bone 'and tankage by means of a sieve having circular openings 1-50 of an inch in diameter. Valuations of bone and tankage are based upon degree of fineness as well as upon composition.

**Dissolved by a neutral solution of ammonium citrate, sp. gr. 1.09, in accordance with method adopted by the Association of Official Agricultural Chemists.

Potash.	Cents per pound 1912.	1913.
As sulfate free from chlorides	5.25	5.25
As muriate (chloride)	4.25	4.25
As carbonate	8.	8.
In cottonseed meal, castor pomace, linseed meal, etc.	5.	5.

RAW PRODUCTS AND CHEMICALS.

Ground Bone. Fifty-one samples of ground bone, representing thirty analyses, have been inspected and appear in this bulletin. The average retail cash price for ground bone has been $31.64 and the average calculated commercial valuation $28.97 per ton. Ground bone has averaged 3.04 per cent nitrogen, 74.68 per cent of which has been found active by the alkaline permanganate method. Four brands were found deficient in nitrogen and nine in phosphoric acid. With three exceptions the deficiency in one element has been offset by an overrun in the other ingredient. Only one brand has shown a commercial shortage of over fifty cents per ton.

E. D. Chittenden Co., No. 910-1138. Nitrogen found 2.17%, guaranteed 2.47%; phosphoric acid found 20.87%, guaranteed 20.60%.

Ground Tankage. Twenty-four samples of tankage have been inspected. Duplicate samples have been composited so that only seventeen analyses have been made. Three samples were found deficient in phosphoric acid and four in nitrogen. The average retail cash price for tankage has been $32.65, and the average calculated commercial valuation $33.09 per ton. The average total nitrogen in tankage was 6.58 per cent, of which 78 per cent has been found active. Nitrogen in fine tankage has cost on the average 18.7 cents; nitrogen in coarse tankage has cost 14.8 cents per pound. Only one sample has shown a commercial shortage of fifty cents per ton.

George E. Marsh Co., No. 587. Nitrogen found 4.87%, guaranteed 5%; total phosphoric acid found 10.69%, guaranteed 12%.

Dissolved Bone. Two analyses of dissolved bone have been made and found well up to the guarantee. The average retail cash price has been $30.50 and the average calculated commercial valuation $25.43 per ton. Dissolved bone has averaged 3.07 per cent nitrogen, of which 79 per cent was found active.

Dry Ground Fish. Fourteen analyses of dry ground fish were made representing thirty-five samples. Four were found deficient in nitrogen and two in phosphoric acid. The average retail cash price has been $41.16 and the average calculated commercial valuation $36.93 per ton. Dry ground fish has averaged 8.07 per cent total nitrogen, about 74 per cent of which has been found active.

Nitrogen from fish has cost on the average 22.3 cents per pound. Two brands showed a commercial shortage of over fifty cents per ton. They are as follows:

The E. D. Chittenden Co., No. 415. Nitrogen found 7.62%, guaranteed 8%; phosphoric acid found 4.16%, guaranteed 6%.

Lister's Agricultural Chemical Works. No. 353. Nitrogen found 7.53%, guaranteed 8.23%; phosphoric acid found 8.29%, guaranteed 11%.

Dried Blood. Seven samples have been inspected, representing six analyses. Two were found deficient in nitrogen. In both cases the nitrogen deficiency was made up in part by phosphoric acid, so that no commercial shortage of over fifty cents per ton resulted. Blood has averaged 9.86 per cent nitrogen, with an activity of 76.98 per cent. Some of the samples have shown a rather high percentage of phosphoric acid, which would indicate the presence of more or less tankage. The average per cent of phosphoric acid was 4.28, the highest amount found being 7.92 per cent. The average retail cash price for blood has been $51.50, and the average calculated commercial valuation $42.46 per ton. The average pound cost of nitrogen from dried blood has been 26.12 cents.

Castor Pomace. Two samples were examined, and in both cases the nitrogen guarantee was well maintained. Only one cash price was procured on castor pomace. This was $22.00 per ton. The average calculated commercial valuation has been $19.12 per ton. The cost of nitrogen, based upon the single cash price furnished, was 24.4 cents per pound. Castor pomace has shown, on an average, 4.78 per cent nitrogen, about 59 per cent of which has been found active.

Cottonseed Meal. Sixty-two samples of cottonseed meal have been examined. All of the meal inspected was bought as a nitrogen source for tobacco and each sample represents a car load of from twenty to thirty tons. The average retail cash price has been $31.90, and the average calculated commercial valuation $25.48 per ton. The average pound cost of nitrogen has been 25 cents. The average per cent of nitrogen in cottonseed meal has been 6.38, about 56 per cent of which was found active by the usual laboratory method.

The following brands have shown a commercial shortage of over 50 cents per ton:

American Cotton Oil Co., No. 484. Nitrogen found 6.17%, guaranteed 6.50%.

Buckeye Cotton Oil Co., No. 6. Nitrogen found, 6.16%, guaranteed 6.50%.

Humphreys-Godwin Co., Nos. 3, 8, 9, 16, 24, 28, 34, 38, 379, 380, 679, 798. Average nitrogen found 6.13%, guaranteed 6. 50%.

Imperial Cotto Milling Co., Nos. 787, 968, 1011, 1123. Average nitrogen found 6.14%, guaranteed 6.50%.

S. P. Davis, No. 1130. Nitrogen found 6.07%, guaranteed 6.50%.

Olds & Whipple, Nos. 7, 26, 27. Average nitrogen found 5.97%, guaranteed 6.50%.

In the case of nitrogen shortages in cottonseed meal it has been the usual custom for the broker to allow a rebate, at the rate of 50 cents per unit for protein. All of the nitrogen shortages noted have been adjusted by a satisfactory rebate.

Occasion is taken here to rectify an error which occurred in the 1912 bulletin in connection with the J. E. Soper Co.'s Prime Cottonseed Meal, No. 1112. A guarantee of 6.50% nitrogen was placed on this sample, when the guarantee should have been 6%. The sample analyzed 6.11% nitrogen and was therefore well above the guarantee.

Nitrate of Soda. Thirty-four samples have been examined, representing seventeen analyses. Six samples were found deficient in nitrogen. Nitrate of soda has cost on the average $56.78, and the average calculated commercial valuation has been $55.57 per ton. The pound of nitrogen from this source has cost on the average of 18.9 cents. Three samples of nitrate of soda have shown a commercial shortage of over 50 cents per ton.

Bowker Fertilizer Co., Nos. 326-329-337. Nitrogen found 14.68%, guaranteed 15%.

International Agricultural Corporation, Buffalo Fertilizer Co. Branch. Nos. 156-629. Nitrogen found 14.72%, guaranteed 15%.

Nitrate Agencies Co., Nos. 213-390-435-719. Nitrogen found 14.72%, guaranteed 15%.

Sulfate of Ammonia. Four analyses have been made, and all but one were above the minimum guarantee. The average retail cash price has been $73.33, and the calculated commercial valuation $76.43 per ton. Sulfate of ammonia has tested on the average 20.65 per cent of nitrogen. The average cost of a pound of nitrogen in this form has been 17.01 cents.

Calcium Cyanamide. Two analyses were made, and the nitrogen guarantee was well maintained. The average retail cash price has been $48.96, and the calculated commercial valuation $54.91 perton. Calcium cyanam ide tested on the average 14.45 per cent nitrogen, and the average cost of the pound of nitrogen from this source has been about 17 cents. Calcium cyanamide carries from 50 to 55 per cent of lime, at least a portion of which should have the desired effect upon soil.

POTASH COMPOUNDS.

High Grade Sulfate of Potash.

Thirty-two samples have been inspected, representing sixteen analyses. There was only one case where the potash guarantee was not maintained. The average retail cash price for this salt has been $49.85, and the average calculated commercial valuation $52.19 per ton.

The average analysis of high grade sulfate of potash showed 49.70 per cent of potassium oxide. The pound of actual potash in this form has cost, on the average, 5.02 cents. Only one sample showed a commercial shortage of over 50 cents per ton.

Lowell Fertilizer Co., No. 216 Potash found 47.48%, guaranteed 48%.

Potash-Magnesia Sulfate.

Six analyses have been made, and the potash guarantee was maintained in all but one case. The average retail cash price has been $29.60 and the average calculated commercial valuation $28.79 per ton. This salt has tested on the average 27.42% actual potash. The average cost of a pound of potash from this source has been 5.40 cents. Three samples have shown an abnormally high percentage of matter insoluble in water. This has been explained as follows by Dr. Huston of the German Kali Works, to whom the matter was referred by the fertilizer companies involved:

"The older grades of sulfate of potash-magnesia contained an excess of magnesia; while under the present working methods the mills have difficulty in supplying materials with a minimum of 25 per cent of sulfate of magnesia or 8.33 per cent actual magnesia. The sulfate of potash-magnesia formerly on the market used to contain about 11 per cent of magnesia, but the methods of manufacture have changed so that only about 20 per cent of sulfate of magnesia has been found in the product." Dr. Huston further states that "last March a commission was appointed in Germany to take up the composition of sulfate of potash-magnesia, and it was finally decided to have the standard material in the future contain 25 per cent sulfate of magnesia or 8.33 per cent actual magnesia (MgO)." It is Dr Huston's opinion that the samples containing the low magnesia tests were shipped previous to the proposals made by the German Commission and during a period when no attempt was made to control the amount of magnesia in the material. In conversation with the writer, Dr. Huston explains the presence of the insoluble matter in the samples by saying that some of the refuse salts used in making the sulfate of potash-magnesia naturally contained a relatively high percentage of siliceous material.

From the above it would seem that salt formerly known as sulfate of potash-magnesia is a thing of the past, and that the product known by that name in the future will in reality be a "dry mix" composed of sulfate of potash and refuse magnesia salts; the final

product having a more complex composition with considerably less magnesia than was formerly found. The samples which showed the low magnesia and the high insoluble matter tests were Nos. 489-1182, sold by the American Agricultural Chemical Company, No. 797, sold by the Bowker Fertilizer Co., and No. 1207, sold by Olds & Whipple. Representatives of the German Kali Works expressed the belief that the insoluble matter was in reality sulfate of magnesia which would become soluble when boiled one hour with water. This test was made with the following results:

	Original Insoluble Matter.	Amt. of Sulfate of Magnesia dissolved by Boiling Water.	Residue after Boiling one Hour.
Nos. 489-1182	14.28	2.09	12.19
No. 797	7.64	2.17	5.47
No. 1207	13.29	4.25	9.04

The above analyses show that only about one-fourth of the insoluble matter was dissolved by boiling water, and therefore the material was not composed largely of Kieserite as was claimed. On the whole these results would tend to support Dr. Huston's explanation.

Muriate of Potash. Seventeen analyses have been made, representing thirty-seven samples. In four cases the potash guarantee was not maintained. The average percentage of potash has been 50.61. The average retail cash price has been $42.10 and the calculated commercial valuation $43.02 per ton. The pound of actual potash has cost on the average 4.16 cents. Three samples have shown a commercial shortage of over 50 cents per ton. They are as follows:

Lowell Fertilizer Co., No. 417. Potash found 49.04%, guaranteed 50%.

Nitrate Agencies Co., No. 382. Potash found 49.16%, guaranteed 50%. It might be said that other samples of muriate sold by this company were found well up to the guarantee.

Whitman & Pratt Rendering Co., No. 950. Potash found 49.40%, guaranteed 50%.

Kainit. Five samples have been analyzed and found as represented. The average retail cash price has been $15.00, and the calculated commercial valuation $12.42 per ton. Cost of potash per pound in this salt has been 5.04 cents.

PHOSPHORIC ACID COMPOUNDS.

Dissolved Bone Black. Five samples of dissolved bone black were examined and no deficiencies were found. The average available phosphoric acid found in this material was 15.97 per cent. The average calculated commercial valuation has been $15.20 per ton.

Acid Phosphate. Nineteen analyses of acid phosphate were made, representing thirty-three samples. In all cases the guarantee of available phosphoric acid has been maintained. The average retail cash price has been $14.63, and the average calculated value has been $14.33 per ton. The average available phosphoric acid found in acid phosphate was 16.04 per cent. The pound of available phosphoric acid has cost 4.56 cents.

Basic Slag Phosphate. Seventeen analyses of Thomas basic slag phosphate have been made, representing twenty-seven samples. Four tests showed the available phosphoric acid below the guarantee. The average retail cash price paid for basic slag was $15.88, and the average calculated commercial valuation $12.96 per ton. Slag has tested on the average 15.09 per cent available phosphoric acid. The pound of available phosphoric acid has averaged 5.26 cents. The following brands showed a commercial shortage of over 50 cents per ton.

Sanderson Fertilizer & Chemical Co., No 174. Total phosphoric acid found 16.20%, guaranteed 17%; available phosphoric acid found 14.14%, guaranteed 15%.

Whitman & Pratt Rendering Co., No. 954. Total phosphoric acid found 12.88%, guaranteed 17%; available phosphoric acid found 12.12%, guaranteed 13%.

MIXED COMPLETE FERTILIZERS.

In making a study of the mixed complete fertilizers, it seems convenient, for the sake of comparison, to divide them into three grades:—high, medium and low. Those brands having a calculated commercial valuation of $24.00 or over per ton have been designated as high grade, between $18.00 and $24.00 per ton, medium grade, and below $18.00 per ton, low grade. The following table shows a comparison of the three grades of fertilizer in relation to retail cash price, calculated commercial value and money difference between cash price and commercial value.

	High Grade.		Medium Grade.		Low Grade.	
	1912	1913	1912	1913	1912	1913
Average retail cash price per ton.	38.23	38.50	33.26	33.19	29.76	29.85
Average calculated commercial value per ton.	27.84	29.50	20.74	20.83	14.58	15.24
Average money difference.	10.39	9.00	12.52	12.36	15.18	14.61

The above table shows:

(1). That on the average the complete mixed fertilizers have cost a little more per ton than for 1912.

(2). That the average calculated commercial value of plant food in a ton has been 81 cents more than for the previous season.

(3). That the percentage excess of the selling price over the calculated commercial value of plant food in the low grade fertilizers is over three times more than in the high grade goods and about one and one half times more than in the medium grade fertilizers.

(4). That with a 28.9 per cent advance in price over the low grade fertilizer, the high grade furnishes about 93.5 per cent increase in commercial plant food value.

(5). The money difference between the average selling price and the average commercial valuation in the high grade fertilizers is $5.61 less than in the low grade goods.

Table showing the average chemical composition of the three grades of fertilizers.

GRADE	Number of Brands	Percent. of Whole Number	Nitrogen: Total	Nitrogen: Percentage Availability of Total Nitrogen	Nitrogen: Percentage Availability of Org. Nitrogen	Phosphoric Acid: Soluble	Phosphoric Acid: Reverted	Phosphoric Acid: Available	Phosphoric Acid: Insoluble	Potassium Oxide	Lbs. of Available Plant Food in 100 Lbs. of Fertilizer
High.	187	52.98	4.01	82.04	70.75	3.54	3.76	7.30	1.61	8.24	18.83
Medium.	97	27.46	2.55	83.92	72.30	4.39	3.26	7.65	1.47	5.15	14.94
Low.	69	19.56	1.68	77.92	64.76	4.48	2.95	7.43	1.29	3.04	11.78

The above table shows:

(1). That a ton of the average high grade fertilizer furnishes 46.6 pounds more nitrogen and 104 pounds more actual potash than does a ton of the low grade goods.

(2). That a ton of the average high grade fertilizer furnishes 29.2 pounds more nitrogen and 61.8 pounds more potash than does a ton of the medium grade goods.

(3). That with a 28.9 per cent advance in price over the low grade fertilizer, the high grade furnishes about 60 per cent increase in available plant food.

(4). The average high grade fretilizer, with about 16 per cent advance in price over the medium grade goods, furnishes over 26 per cent more plant food and 41 per cent increase in commercial value.

(5). The percentage activity of total nitrogen was found to be 4.12, and the percentage activity of the organic nitrogen was 5.99 per cent more in the high grade fertilizer than in the low grade brands.

(6). When compared with the previous year it is found that the percentage activity of the organic nitrogen in all of the grades of fertilizer has been considerably improved. This would indicate greater care in manufacture than has hitherto prevailed.

Table showing the comparative cost per pound of nitrogen, potash and phosphoric acid in its various forms in the three grades of fertilizers.

FORMS OF ELEMENT	Low Grade Fertilizer	Medium Grade Fertilizer	High Grade Fertilizer
Nitrogen (as nitrates and ammoniates)	36.2 cts.	29.5 cts.	24.1 cts.
Nitrogen (organic)	37.2 "	30.2 "	24.8 "
Potash (as muriate)	8.3 "	6.8 "	5.5 "
Soluble phosphoric acid	8.8 "	7.1 "	5.9 "
Reverted phosphoric acid	7.8 "	6.4 "	5.2 "
Insoluble phosphoric acid	3.9 "	3.2 "	2.6 "

This summary shows:

(1). The most economical fertilizer to buy is the "high grade" or the one valuing commercially $24.00 or over per ton.

(2). The purchaser of high grade fertilizers in place of low grade would save 12¼ cents on every pound of nitrogen and nearly 3 cents on every pound of potash and phosphoric acid.

(3). Nitrogen in medium grade fertilizers has cost 6¾ cents and potash and phosphoric acid 1½ cents per pound more than in high grade goods.

(4). The plant food in a ton of the average high grade fertilizer has cost $37.65. This same amount of plant food, if paid for on the basis of the cost of the fertilizer elements in the low grade goods, would have amounted to $56.49, an increase of $18.87. If purchased in the form of medium grade fertilizer, the same amount of plant food would have cost $46.06.

(5). About 47 percent of the brands of fertilizer sold in the State are classed as low and medium grade. This shows an improvement over the preceding year when 52 per cent of the brands belonged to these two classes.

Summary of results of analyses of complete fertilizers as compared with guarantee:

MANUFACTURER.	No. of Brands Analyzed	No. with all three elements equal to guarantee	No. equal to guarantee in commercial value	No. with one element below guarantee	No. with two elements below guarantee	No. with three elements below guarantee.
W. H. Abbott	3	2	3	1	—	—
Alphano Humus Co	1	1	1	—	—	—
American Agric. Chemical Co.	71	34	68	31	6	—
Armour Fertilizer Works	10	7	10	3	—	—
Atlantic Fertilizer Co.	2	1	2	1	—	—
Beach Soap Co	5	3	5	2	—	—
Berkshire Fertilizer Co.	10	10	10	—	—	—
C. M. Bolles	1	—	1	1	—	—
Bowker Fertilizer Co	25	16	24	9	—	—
Joseph Breck & Sons, Corp.	3	—	2	3	—	—
E. D. Chittenden Co	7	5	7	2	—	—
Clay & Son	1	1	1	—	—	—
Coe-Mortimer Co	16	7	12	4	4	1
Eastern Chemical Co.	1	—	1	—	1	—
Essex Fertilizer Co.	11	4	9	5	2	—
C. W. Hastings	1	—	—	—	1	—
R. & J. Farquhar & Co	1	1	1	—	—	—
International Agricultural Corporation	9	3	9	5	1	—
Johnson Seed Potato Co.	2	—	1	1	1	—
Lister's Agric. Chemical Works	10	7	10	3	—	—
Lowell Fertilizer Co.	13	7	12	6	—	—
Jas. E. McGovern	1	1	1	—	—	—
Manufacturer's Wool Stock Co.	1	—	—	—	1	—
Mapes' Formula & Per. Guano Co.	17	14	15	2	1	—
National Fertilizer Co	15	8	12	5	2	—
Natural Guano Co.	1	1	1	—	—	—
New England Fertilizer Co.	7	2	6	5	—	—
Olds & Whipple	7	7	7	—	—	—
Pan American Fertilizer Co.	1	1	1	—	—	—
Parmenter & Polsey Fert. Co.	7	6	7	1	—	—
R. T. Prentiss	3	2	3	—	1	—
Pulverized Manure Co.	2	2	2	—	—	—
Rogers Manufacturing Co.	10	9	10	1	—	—
Rogers & Hubbard Co.	10	7	10	3	—	—
Ross Bros. Co.	4	1	4	3	—	—
F. S. Royster Guano Co.	10	5	8	4	1	—
J. W. Sanborn	3	2	3	1	—	—
Sanderson Fert. & Chem. Co.	8	7	8	1	—	—
M. L. Shoemaker & Co.	1	1	1	—	—	—
A. M. Smith & Co.	1	1	1	—	—	—
Wm. Thomson & Sons	2	2	2	—	—	—
20th Century Specialty Co.	3	3	3	—	—	—
Whitman & Pratt Rendering Co.	5	5	5	—	—	—
Wilcox Fertilizer Co.	10	10	10	—	—	—
A. H. Wood & Co.	3	1	3	1	1	—

The table on the opposite page shows:

(1). That out of a total of 335 brands of complete fertilizers analyzed, 128 (28 per cent of the total number) fell below the minimum guarantee in one or more elements; these deficiencies may be expressed as follows:

104 brands deficient in one element.

23 brands deficient in two elements.

1 brand deficient in all three elements.

(2). That 23 brands (about 7 per cent of the whole number) showed a commercial shortage; that is, when overruns were used to offset shortages, the value of the plant food found did not equal the value guaranteed. The following deficiencies were found:

89 brands were deficient in nitrogen.

34 brands were deficient in available phosphoric acid.

30 brands were deficient in potash.

(3). More nitrogen and available phosphoric acid deficiencies were recorded than for the previous season. There were 12 less potash shortages and the commercial shortages were 3 less than for 1912.

Table showing commercial shortages (25 cents and over per ton) in mixed commercial fertilizers for 1912 and 1913.

Commercial Shortages	Number of Brands	
	1912.	1913.
More than $2.00 per ton	—	2
Between $1.00 and $2.00 per ton	8	9
Under $1.00 not less than 25 cts. per ton	15	7

The following brands have shown a commercial shortage of 50 cents or over per ton, value of overruns being used in all cases to reduce shortages.

American Agricultural Chemical Co., Complete Tobacco Fertilizer No. 80. Nitrogen found 3.97%, guaranteed 4.53%; available phosphoric acid found 3.04%, guaranteed 3%; potash found 5.70%, guaranteed 5.50%.

Bradley's Complete Manure for Top Dressing Grass and Grain, Nos. 193-442-567. Nitrogen found 4.69%, guaranteed 4.94%; available phosphoric acid found 4.04%, guaranteed 4%; potash found 6.41%, guaranteed 6%.

Bradley's English Lawn Fertilizer, No. 527. Nitrogen found 4.42 per cent guaranteed 4.94%; available phosphoric acid found 4.21%, guaranteed 4%; potash found 6.26%, guaranteed 6%.

Joseph Breck & Sons Corp., Breck's Lawn and Garden Dressing, No. 478. Nitrogen found 3.80%, guaranteed 4.11%; available phosphoric acid found 5.36%, guaranteed 5%; potash found 5.31%, guaranteed 5%.

Coe-Mortimer Co., Double Strength Top Dressing, No. 1225. Nitrogen found 7.76%, guaranteed 8.23%; available phosphoric acid found 7.35%, guaranteed 7%; potash 7.89%, guaranteed 8%.

Peruvian Grass Top Dressing, No 1224. Nitrogen found 7.96%; guaranteed 8.23%; available phosphoric acid found 4.54%, guaranteed 4.50; potash found 5.76%, guaranteed 6%.

Special Grass Top Dressing, No. 225. Nitrogen found 4.55%, guaranteed 4.94%; available phosphoric acid found 4.37%, guaranteed 4%; potash found 2.84%, guaranteed 3%.

Essex Fertilizer Co., Essex Lawn Dressing, Nos. 273-746. Nitrogen found 3.51%, guaranteed 4.10%; available phosphoric acid found 8.42%, guaranteed 7%; potash found 5.48%, guaranteed 6%.

Chas. W. Hastings., Ferti Flora, No. 1060. Nitrogen found 2.94%, guaranteed 3.25%; available phosphoric acid found 3.25%, guaranteed 3.67%; potash found 3.35%, guaranteed 3.30%.

Johnson Seed Potato Co., Ideal Potato Manure, Hoeing Brand, No. 1210. Nitrogen found 3.19%, guaranteed 3.29%; available phosphoric acid found 8.57%, guaranteed 6%; potash found 8.69%, guaranteed 10%.

Mapes Formula & Peruvian Guano Co., Top Dresser Improved, Full Strength, No. 520. Nitrogen found 8.95%, guaranteed 9.88%; available phosphoric acid found 8.24%, guaranteed 5%; potash found 3.75%, guaranteed 4%.

National Fertilizer Co., Chittenden's Connecticut Valley Tobacco Starter, No. 1106. Nitrogen found 7.04%, guaranteed 8.23%; available phosphoric acid found 4.34%, guaranteed 1%; potash found 3.17%, guaranteed 2.50%.

Chittenden's High Grade Special Tobacco Fertilizer, No. 819. Nitrogen found 5.11%, guaranteed 5.76%; available phosphoric acid found 5.84%, guaranteed 5%; potash found 8.60%, guaranteed 10%.

F. S. Royster Guano Co., Royster's Royal Special Potato Guano, No. 713. Nitrogen found 3.63%, guaranteed 4.11%; available phosphoric acid found 7.61%, guaranteed 7%; potash found 7.83%, guaranteed 7%.

QUALITY OF PLANT FOOD.

Character of Nitrogen.

A study of the forms of nitrogen in the different grades of fertilizer furnishes interesting and suggestive data. There is no reason to question the availability of the mineral forms of nitrogen in fertilizers,—whether in the form of nitrate of soda or sulfate of ammonia, both salts being soluble in water. As might be expected, there is a varying proportion of mineral nitrogen found in the brands offered by different manufacturers and it is probable that the lower cost of nitrogen from this source has a tendency to an increased use of this

form of nitrogen. On open porous sandy soils, deficient in organic matter and humus, it would probably not be good economy to use too large a proportion of mineral nitrogen, as a serious loss from leaching would be likely to occur.

In the complete commercial fertilizers analyzed, it was found that in the low grades 37.5% and in the high and medium grades 47.3% of the total nitrogen was from mineral sources.

The quality of the organic nitrogen in the various grades of fertilizer may be indicated from the following data:

In the low grade fertilizers 62.5% of the total nitrogen was present in organic form. In the high and medium grade fertilizers 52.7% of the total nitrogen was from organic sources. Twenty-six cases were found in which there is reason to question the quality of the organic nitrogen; thirteen, or 50% of the whole number, were from low grade fertilizers, (that is, valuing commercially less than $18.00 per ton.) Five out of the 26 were from medium grade and 8 were from high grade goods. The above facts indicate that, as a general rule, the organic nitrogen in the cheaper grades of fertilizer is not derived from as high grade sources as in the better grades.

The organic nitrogen has been reported in the present bulletin in the same manner as heretofore, namely:—*Water soluble organic nitrogen*, *active water insoluble organic nitrogen* and *inactive water insoluble organic nitrogen.* The data furnished by each detailed analysis is considered sufficient to enable anyone to readily detect cases in which at least a portion of the organic nitrogen has been derived from inferior sources.

It is our purpose, during the winter, to test, by vegetation experiments in pots, the actual availability of the water insoluble nitrogen in those samples which have shown a low activity by the laboratory method.

As has been pointed out in a previous bulletin, in judging the quality of the organic nitrogen in any fertilizer, three things should be considered:—

1. The proportion of the organic nitrogen soluble in water.

2. The percentage activity of the water insoluble organic nitrogen.

3. The excess of nitrogen which has been furnished over the guarantee. Wherever a considerable quantity of organic nitrogen is present it may be said, in general, that cases should be viewed with suspicion which show the following characteristics:—

(a) *Small amount of water soluble organic nitrogen.*

(b) *The inactive water insoluble organic nitrogen equaling or exceeding the active water insoluble organic nitrogen.*

(c) *The total nitrogen found not much in excess of guarantee.*

When the minimum nitrogen guarantee is made up of nitrogen in available form and the test shows that 50 percent of the water insoluble nitrogen is inactive, the indications are that 200 pounds or so of some low grade organic substance (such as peat or garbage tankage) was used as a conditioner. Such cases should not be condemned, for it is necessary to have a certain proportion of organic matter present to avoid caking and insure a good mechanical mixture and one that can be properly distributed by the drilling machine. Wherever a conditioner of this sort is used it should be, of course, so stated on the tag.

The following summary table shows the average amount found and the quality of nitrogen used by each manufacturer in the brands sold during 1913. See table on opposite page.

MANUFACTURER.	Number of Brands	Total Nitrogen	Percentage Activity of Total Nitrogen	Nitrates and Ammoniates	Total Organic Nitrogen	Percentage Activity of Total Organic Nitrogen	Percentage Activity of the Water Insoluble Organic Nitrogen
W. H. Abbott	3	3.59	78.00	1.08	2.51	68.53	54.85
Alphano Humus Co.	1	2.84	47.51	.84	2.00	25.50	36.05
American Agric. Chem. Co.	71	2.56	86.34	1.36	1.20	70.83	59.30
Armour Fertilizer Works,	11	2.84	77.47	.94	1.90	66.31	60.25
Atlantic Fertilizer Co.	2	2.81	86.48	.55	2.26	83.19	51.28
Beach Soap Co.	6	3.52	85.24	1.69	1.83	71.59	50.48
Berkshire Fertilizer Co.	10	3.80	81.58	1.57	2.23	68.61	62.77
C. M. Bolles	1	2.96	88.52	1.88	1.08	68.52	55.27
Bowker Fertilizer Co.	25	2.96	87.84	1.86	1.10	67.28	59.55
Jos. Breck & Sons Corp.	3	2.80	80.36	1.60	1.20	53.34	37.50
E. D. Chittenden Co	7	4.11	82.00	1.77	2.34	68.38	53.76
Clay & Sons	1	4.46	80.27	2.22	2.24	60.72	59.26
Coe-Mortimer Co.	16	3.85	91.69	2.25	1.60	80.00	65.96
Essex Fertilizer Co.	12	2.85	83.51	.78	2.07	77.30	58.41
R. & J. Farquhar & Co.	1	1.38	45.65	—	1.38	45.65	33.04
International Agric. Corp. (Buffalo Fertilizer Works)	9	2.79	85.31	1.28	1.51	72.85	57.30
Johnson Seed Potato Co.	2	3.21	90.97	2.37	.84	65.48	54.69
Lister's Agric. Chem. Works	10	2.36	84.32	1.06	1.30	71.55	57.47
Lowell Fertilizer Co.	13	2.74	80.66	.40	2.34	77.35	59.85
James E. McGovern	1	3.77	70.02	.36	3.41	66.86	53.69
Manft. Wool Stock Co.	1	1.35	65.18	—	1.35	65.18	41.25
Mapes' Form. & Per. Guano Co.	17	3.83	88.51	2.44	1.39	61.15	54.64
National Fertilizer Co.	15	3.66	81.15	1.47	2.19	68.50	61.88
Natural Guano Co.	1	2.41	53.53	—	2.41	53.53	30.87
New England Fertilizer Co.	7	2.72	82.36	.46	2.26	78.76	62.50
Olds & Whipple	7	3.61	73.69	1.14	2.47	61.54	55.40
Pan American Fertilizer Co.	1	2.49	83.54	1.50	.99	58.58	56.38
Parmenter & Polsey Fert. Co.	7	2.84	80.99	.21	2.63	79.47	62.76
R. T. Prentiss	3	4.00	91.75	2.93	1.07	69.16	57.70
Pulverized Manure Co.	2	2.76	54.71	—	2.76	54.71	30.17
Rogers Manufacturing Co.	10	3.93	77.86	1.01	2.92	70.20	62.34
Rogers & Hubbard Co.	10	4.47	86.80	2.61	1.86	68.28	62.90
Ross Bros. Co.	4	2.39	79.92	.94	1.45	66.90	63.36
F. S. Royster Guano Co.	10	3.11	86.18	1.79	1.32	67.42	59.43
J. W. Sanborn	3	3.68	94.30	2.85	.83	74.70	68.66
Sanderson Fert. & Chem. Co.	8	3.18	72.02	.71	2.47	63.97	55.94
M. L. Shoemaker & Co.	1	2.94	76.88	.83	2.11	67.78	58.03
A. M. Smith & Co.	1	7.25	73.80	—	7.25	73.80	65.02
Wm. Thomson & Sons	2	4.27	86.66	2.10	2.17	73.74	68.16
20th Century Specialty Co.	3	2.29	99.13	1.97	.32	—	—
Whitman & Pratt Rend. Co.	5	2.80	76.79	.86	1.94	66.50	56.96
Wilcox Fertilizer Co.	10	3.08	75.98	1.02	2.06	64.08	56.72
A. H. Wood & Co	3	3.77	92.84	3.13	.64	57.82	54.24

It will be noticed in the above table that some manufacturers' goods show a high total nitrogen activity and a satisfactory total organic nitrogen activity; while the percentage activity of the water insoluble organic nitrogen is low. In some of these cases the manufacturers make no secret of the fact that they are using 200 pounds of peat or garbage tankage as a conditioner. As a reason therefor it is claimed that a large proportion of the fertilizer mixture is derived from chemicals having a tendency to cake; hence, to insure a satisfying mechanical product, it is necessary to use a small amount of such material. There can be no objection to this practice, provided the nitrogen contained in the conditioner is not counted in the guarantee and a statement appears on the tag that such products have been used for this purpose. It is not, of course, absolutely necessary to use these low grade products to insure a good drillable fertilizer. A suitable amount of high grade animal and vegetable ammoniates will prove quite as effective, but would have a tendency, perhaps, to increase the cost of the fertilizer.

Character of Phosphoric Acid.

Eighty-four percent of the total phosphoric acid found in all of the complete fertilizers analyzed was present in available form, and forty-two percent of the available phosphoric acid was present in water soluble form. These figures compare favorably with results secured during the previous season. As might be expected, the percentage of solubility and availability of the phosphoric acid in the acid phosphate is considerably more than what is found in the mixed fertilizers. This is undoubtedly due in part to the use of more or less undissolved tankage and bone in the mixed goods. Ninety-five percent of the average total phosphoric acid found in 19 samples of acid phosphate was classed as available and seventy-two percent of the available phosphoric acid was in water soluble form.

Character of Potash

In general it may be said that the character of the potash found in the mixed fertilizers has been as represented. Most of the brands furnished the potash in form of muriate. In the tables of analyses, wherever the potash is in form of sulfate or carbonate, an asterisk (*) or dagger (†) has been used in the "found" potash column. These characters refer to footnotes giving the proportion of each form of potash. Analyses published without these characters indicate that all the potash present is as chloride. The presence of chlorine in tobacco goods is perhaps more undesirable than in any other special crop fertilizer. It is not always possible to avoid a small amount in any fertilizer, as the highest grades of agricultural chemicals actually contain a little of this ingredient. This should be looked upon as no worse than what actually happens when five or six cords of manure are used per acre. It should, of course, be the

aim of the manufacturer to eliminate chlorine from his tobacco brands, and it is also important, when furnishing potash in form of carbonate to eliminate soluble sulfates.

Thirty-eight analyses, representing twenty-nine brands of tobacco fertilizer, with potash guaranteed as sulfate, showed total water soluble potash 7.07%, of which 5.92% was from sulfate and 1.15% from muriate. Ten analyses, representing eight brands, with potash guaranteed as carbonate, showed total water soluble potash 7.91%, of which 5.40% was as claimed, .74% was as muriate and 1.97% as sulfate. Two cases were found where evidently an error occurred in making the goods:

Pan American Fertilizer Co. Market Garden Standard No. 208. 6% of potash was guaranteed, all as sulfate. Enough chlorine was present to unite with all of the potash found, 6.34%.

Rogers Manufacturing Co. High Grade Tobacco Grower, Vegetable and Carbonate Formula. Nos. 94-404-632. 5.50% of potash was guaranteed as carbonate. Enough chlorine was found to unite with .49% of potash and enough soluble sulfates were present to unite with the remainder of the potash. In this case there was undoubtedly some carbonate of potash present, as carbonic acid was driven off upon the addition of hydrochloric acid to the fertilizer. The soluble sulfates may have come from ammonium sulfate or dissolved phosphates used in the mixture.

NEW MINERAL FERTILIZER AND STONEMEAL.

Two samples of New Mineral Fertilizer, manufactured by the New Mineral Fertilizer Co., 11 South Market St., Boston, Mass., were taken by our inspectors. One sample was procured from stock carried by the manufacturer, the other from W. L. Stone & Sons, South Sudbury, Mass. The analyses showed the presence of .11% nitrogen, .13% total phosphoric acid and .16% potash soluble in dilute hydrochloric acid. According to the table of trade values, the plant food in a ton of this product would value commercially about 68 cents.

Three samples of Stonemeal put out by the Stonemeal Fertilizer Co. of Paterson, N. J., and forwarded at our request, were analyzed and the detailed results of analysis will be found in the tables under the headings "Fertilizers for Private Use." These products carry a little more potash and phosphoric acid than does the New Mineral Fertilizer. They also carry from 17.38% to 23.51% of calcium and magnesium oxides, these two elements being present largely in the form of carbonate. The products value commercially from $1.62 to $2.64 per ton, including an allowance of 40 cents for every 100 lbs. of calcium oxide which the products contain. Although our inspectors have found but little of these ground rock products in the

hands of agents, yet we are led to believe, through many inquiries, which reach us through correspondence, that a considerable quantity of the New Mineral Fertilizer is bought by farmers from year to year.

Field Experiments with New Mineral Fertilizer and Stonemeal.

Although chemical analysis has repeatedly shown that these products are worth but little as sources of plant food, yet in view of the extravagant claims made by the manufacturers and promoters it was thought best to make a field experiment with several crops to establish the actual worth of the products as measured in terms of crop production. A field was secured which offered natural advantages for an experiment of this nature, the land being level, of fair mechanical condition, reasonably free from stones and somewhat deficient in available plant food. Previous to the experiment no fertilizer or manure had been used on the soil for many years, and an annual crop of hay had been removed. The field was carefully surveyed and marked off into 24 fortieth-acre plats. The whole field was plowed in the fall of 1912, and the plats to be limed received an application in the early spring, at which time they were thoroughly disc harrowed. The crops employed were corn, potatoes and oats. Each experiment was run in duplicate, the duplicate plats in each crop being located in different parts of the field so as to equalize any natural advantages or disadvantages which might develop to influence the experiment. The entire experiment, from the time the field was plowed until the harvest of the crops, was in charge of Mr. E. F. Gaskill, Assistant Agriculturist of the Experiment Station.

Corn Experiment.

Eight of the plats were devoted to this crop. The different plats received fertilizer at the following rates per acre:

Plats 1 and 6. Lime one ton, manure four cords (applied May 3d and disked in). High Grade Sulfate of Potash 150 pounds, Basic Slag Phosphate 500 pounds, Tankage 150 pounds, Nitrate of Soda 100 pounds.

Plats 2 and 4. New Mineral Fertilizer, one ton per acre.

Plats 3 and 8. No fertilizer or lime.

Plats 5 and 7. Stonemeal ("O" grade, for oats and corn), one ton per acre.

On May 27th the fertilizer was applied as per schedule, the field fitted, and on May 28th the corn was planted. During the summer the crop was cultivated six times and hoed twice, each plat receiving the same treatment. The crop was cut and stooked September 15th, husked October 22d, and weighed October 30th,

On the same day that the corn was weighed, samples of sound and unsound corn, as well as the stover, were sent to the laboratory for dry matter determinations.

The following table gives a summary of the yields of dry matter on the acre basis:

Summary of Yields of Corn and Stover.

Plats	Fertilizer	Weight of Dry Matter, Corn and Cob. Pounds per Acre.	Weight of Dry Matter, Stover. Pounds per Acre.	Proportion of Sound Corn in Total Yield. Percentage Basis.
1 and 6	Lime Manure & Complete Fertilizer	2301.72	2583.18	71.25
2 and 4	New Mineral Fertilizer	1646.51	1846.90	44.79
3 and 8	No Fertilizer. No Lime.	1243.35	1841.90	46.05
5 and 7	Stonemeal, "O" Grade	1509.99	1757.62	42.27

Potato Experiment.

Eight plats were devoted to potatoes and received fertilizer at the following rates per acre:

Plats 3 and 6. Manure, four cords (applied May 3d and disked in). Tankage 400 pounds, Nitrate of Soda 100 pounds, High Grade Sulfate of Potash 220 pounds and Acid Phosphate 400 pounds.

Plats 4 and 5, which were on opposite sides of the field received New Mineral Fertilizer 1 ton.

Plats 1 and 8. No fertilizer.

Plats 2 and 7. Stonemeal, "P" grade, 1 ton.

The fertilizer was applied, the land fitted and the crop planted May 22d. During the summer the crop was cultivated five times, hoed twice, sprayed with Bordeaux mixture seven times, on three

occasions of which arsenate of lead was added to the mixture. The crop was harvested October 6th and 7th. No extra large tubers were in evidence on any of the plats. The potatoes on all of the plats were free from scab, medium in size, smooth and clean. Dry matter determinations were made on the same day that weights were recorded.

The following table gives a summary of yields of dry matter on an acre basis:

Summary of Yield of Potatoes.

Plats	Fertilizer	Total Weight of Dry Matter. Pounds Per Acre.	Proportion of Merchantable Potatoes in Total Yield.
Plats 3 and 6	Manure and Com. Fertilizer	1449.73	91.04%
Plats 4 and 5	New Mineral Fertilizer.	884.22	77.86%
Plats 1 and 8	No Fertilizer	802.94	78.12%
Plats 2 and 7	Stonemeal "P"	869.60	83.58%

Oat Experiment.

Eight plats were used and received fertilizer at the following rates per acre:

Plats 4 and 6. Lime one ton, Manure 4 cords (applied May 3d and disked in.) Nitrate of Soda 150 pounds, Tankage 200 pounds, Sulfate of Potash, high grade, 200 pounds, Acid Phosphate 400 pounds.

Plats 3 and 5. New Mineral Fertilizer, 1 ton.

Plats 1 and 8. No fertilizer or lime.

Plats 2 and 7. Stonemeal, "O" grade, 1 ton.

The fertilizer was applied as per schedule, the land fitted and crop sown May 16th. Although the crop did not suffer particularly from rust, yet it was thought best to cut and dry the same before maturity. The oats were cut September 8th, weighed September 10th, and dry matter determinations made.

The following table gives a summary of yields of dry matter on an acre basis:

Summary of Yield of Oats.

Plats.	Fertilizer.	Total Weight of Dry Matter. Pounds per Acre.
Plats 4 and 6	Lime, Manure and Complete Fertilizer.	3209.15
Plats 3 and 5	New Mineral Fertilizer.	1282.38
Plats 1 and 8	No Fertilizer or Lime.	1253.15
Plats 2 and 7	Stonemeal "O" Grade.	1427.91

General Conclusions

The following table shows the increase in dry matter due to the several fertilizers on the basis of the no fertilizer plats at 100.

Fertilizer.	Corn, Cob and Stover.	Potatoes.	Oats.
No Fertilizer.	100	100	100
Complete Fertilizer.	158	180	256
New Mineral.	113	110	102
Stonemeal.	106	108	114

Although the above experiments indicate that apparent slight benefits have resulted from the use of the ground rock fertilizers, yet they also prove that the extravagant claims made by the manufacturers of these products are in no way confirmed. It should be

noted that the experiment has been in progress but one year and that conditions for a maximum crop were poor, due to an exceedingly dry summer,—hence positive deductions cannot be drawn. It seems safe to state, however, that farmers are in no way warranted in purchasing this class of material as a source of plant food.

The experiment will be continued another year.

LIME COMPOUNDS.

Samples of various lime compounds have been analyzed and are listed in the tables as *Agricultural Lime*, *Ground Limestone*, *Marl*, *Lime Ashes* and *Gypsum*. Among the brands of so-called *agricultural lime* will be found the more active forms, such as ground burned lime, containing a considerable proportion of caustic lime as well as varying amounts of hydrated lime and carbonate of lime; slaked or hydrated lime which has received just enough water to cause it to crumble to a powder; air slaked and refuse lime, which represents residues from the kilns used in burning the high grade building limes. The *ground limestone* contains all of its lime in the form of carbonate and is simply pulverized limestone. The *marl* has the same chemical composition as the limestone; that is, the lime is all present as carbonate. The material, however, has an amorphous instead of a crystalline form. *Lime ashes* are a refuse product from the lime kilns. They are apt to vary considerably in composition, depending upon the length of time that they have been exposed to the weather and upon the nature of the fuel used in the burning process. When wood is used the ashes will contain an appreciable amount of potash and a little phosphoric acid. *Gypsum*, or land plaster, contains nearly all of its lime in form of sulfate. This product does not have a sweetening effect upon the soils and should not be bought for this purpose. It does have a beneficial effect upon some soils, and by a chemical interchange of acids and bases, will liberate insoluble plant food.

The lime samples analyzed are as follows:

Agricultural Limes,	21	analyses,	representing	19	brands.
Ground Limestones,	5	”	”	4	”
Marls,	2	”	”	2	”
Lime Ashes,	7	”	”	7	”
Gypsum,	5	”	”	3	”

On pages 93 and 95 will be found the results of analysis of the various lime products, that is, the actual determinations. Reading across on the opposite page will be found the probable combinations of the ingredients as calculated from the analytical data.

Wherever our inspectors were able to procure cash prices we have figured the average cost of 100 pounds of calcium and magnesium oxides for each product. The prices were based on carload lots delivered in bags for cash.

The lime compounds varied widely in composition, as might be expected. Particularly is this true of the so-called agricultural limes and the lime ashes. The ground limestone, marl and gypsum were more constant in composition. The guarantees on all of the products have been, as a rule, well maintained,—many of the materials having overrun their minimum guarantee by wide margins.

No attempt will be made at this time to discuss the rational use of lime. For information of this character see bulletin No. 137.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
W. H. Abbott, Holyoke, Mass.				
Abbott's Eagle Brand	Whately	$30 95	584	7.53
" Onion Fertilizer	Whately	30 85	579	5.51
" Tobacco Fertilizer	Sunderland	34 20	279	4.82
Alphano Humus Co., Whitehall Bldg., New York City.				
Prepared Alphano Humus	Manf'r's Sample	10.24	1242	9.99
American Agric. Chem. Co., 92 State St., Boston, Mass.				
Church's Fish and Potash, D	Deerfield		130	
" " " " "	New Bedford	16.25	260	9.83
" " " " "	Whitman		446	
Church's Fish and Potash D	Taunton	15.82	744	7.62
Complete Tobacco Manure	Bradstreet	24 98	80	8.38
East India A. A. Ammoniated Superphosphate	New Bedford	19 88	249	11.36
First Year Top Dressing	N. Amherst	29.28	176	7.91
Grass and Lawn Top Dressing	Millis	21 12	427	8.81
" " " " "	Boston		519	
Grass and Lawn Top Dressing	Hamilton	20 09	658	7.30
" " " " "	Norwood		903	
High Grade Fertilizer with 10% Potash	Hamilton	24.09	664	7.19
" " " " " " "	Cushman		733	
High Grade Fertilizer with 10% Potash	Barre Plains	23 97	1151	6.09
Northwestern Empire Special Manure	Fall River	26 51	339	10.89
Special Grass and Garden Mixture	Concord	42 48	398	6.55
" " " " "	S. Barre		1154	
Tobacco Starter and Grower	Bradstreet		68	
" " " "	Sunderland	25.11	189	9.52
" " " "	Sunderland		200	
Tobacco Starter and Grower	Worcester	25 61	1027	9.59
Bradley's Corn Phosphate	Millis	15 83	433	7.66
" " "	Plymouth		464	
Bradley's Corn Phosphate	Fitchburg		805	
" " "	S. Sudbury	19 15	1098	10.78
" " "	Agawam		1128	
" " "	N. Wilbraham		1134	
Bradley's Complete Manure for Corn and Grain	Sunderland	26.55	192	10.38
" " " " " " "	Boston		566	
Bradley's Complete Manure for Corn and Grain	Worcester	26 81	832	8.78
" " " " " " "	W. Upton		921	
Bradley's Complete Man. for Potatoes and Vegetables	Bradstreet		82	
" " " " " " "	Millis	25.92	426	11.96
" " " " " " "	Rockland		454	
Bradley's Complete Man. for Potatoes and Vegetables	E. Longmeadow	26.73	1008	11 57
Bradley's Com. Man. for Top Dress. Grass and Grain	Sunderland		193	
" " " " " " " " "	Amesbury	26.72	442	6.99
" " " " " " " " "	Boston		567	
Bradley's Complete Manure with 10% Potash	Amherst	28.38	55	8.27
" " " " " "	Boston		514	
Bradley's Complete Manure with 10% Potash	S. Framingham	27.52	1055	6.26

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble, Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.18	.79	1.05	.88	2.90	2.50	.55	8.91	4.52	13.98	12.00	9.46	9.00	10.17*	10.00
1.32	.67	.87	.77	3.63	3.50	.45	7.97	4.57	12.99	10.00	8.42	7.00	8.30*	7.00
1.75	.81	.95	.73	4.24	4.00	.55	8.10	4.34	12.99	10.00	8.65	7.00	9.24*	10.00
												.50		
.44	.07	.44	1.49	2.84	1.25	—	1.08	.31	1.39	—	1.08		1.06†	.50
.76	.50	.48	.34	2.08	2.06	3.87	2.56	1.94	8.37	7.00	6.43	6.00	2.48	2.00
.93	.35	.45	.37	2.10	2.06	3.80	2.25	1.22	7.27	7.00	6.05	6.00	2.61	2.00
.28	.72	1.64	1.33	3.97	4.53	.48	2.56	.51	3.55	4.00	3.04	3.00	5.70*	5.50
1.11	.21	.68	.48	2.48	2.47	6.31	2.50	2.42	11.23	10.00	8.81	9.00	2.25	2.00
2.39	.22	.60	.35	3.56	3.70	4.08	3.04	1.63	8.75	8.00	7.12	7.00	10.87	10.00
3.77	—	.11	.05	3.93	3.91	1.88	3.32	.54	5.74	6.00	5.20	5.00	2.34	2.00
3.53	.01	.03	.03	3.60	3.91	2.36	3.00	.43	5.79	6.00	5.36	5.00	2.44	2.00
1.33	.44	.41	.33	2.51	2.47	4.06	1.98	1.05	7.09	7.00	6.04	6.00	10.64	10.00
1.28	.44	.51	.28	2.51	2.47	2.78	3.26	1.28	7.32	7.00	6.04	6.00	10.52	10.00
1.97	.38	.63	.34	3.32	3.29	5.14	3.21	2.14	10.49	9.00	8.35	8.00	7.09	7.00
5.13	1.00	1.25	.50	7.88	8.43	2.84	3.64	1.58	8.06	7.25	6.48	6.25	8.18	8.25
2.08	.26	.61	.34	3.29	3.29	5.40	2.66	2.07	10.13	9.00	8.06	8.00	4.98*	4.00
1.09	.62	1.09	.67	3.47	3.29	4.69	3.48	3.21	11.33	9.00	8.17	8.00	4.34*	4.00
1.07	.24	.32	.25	1.88	2.06	4.78	3.28	1.30	9.36	9.00	8.06	8.00	1.59	1.50
1.08	.35	.46	.37	2.26	2.06	4.85	3.69	1.51	10.05	9.00	8.54	8.00	3.23	1.50
2.22	.33	.41	.35	3.31	3.29	5.87	2.06	1.94	9.87	9.00	7.93	8.00	7.64	7.00
2.07	.40	.57	.33	3.37	3.29	4.72	3.27	1.68	9.67	9.00	7.99	8.00	7.85	7.00
1.98	.34	.41	.30	3.03	3.29	6.19	2.59	1.30	10.08	9.00	8.78	8.00	7.58	7.00
1.84	.53	.54	.38	3.29	3.29	5.91	2.31	1.63	9.85	9.00	8.22	8.00	7.75	7.00
4.41	.07	.11	.10	4.69	4.94	2.55	1.49	.99	5.03	5.00	4.04	4.00	6.41	6.00
1.66	.47	.77	.51	3.41	3.29	3.51	2.74	2.19	8.44	7.00	6.26	6.00	11.01	10.00
1.24	.84	.74	.45	3.27	3.29	2.61	3.95	1.99	8.55	7.00	6.56	6.00	10.48	10.00

* No. 584 Chlorine .67% equivalent to .88% potash, 9.29% potash as sulfate.
" 579 " .57% " " .76% " 7.54% " " "
" 279 " .62% " " .81% " 8.43% " " "
" 80 " .79% " " 1.05% " 1.98% " " " 2.67% potash as carb.
" 68-189-200 " .82% " " 1.08% " 3.88% " " "
" 1027 " 1.09% " " 1.46% " 2.88% " " "
† " 1242 Total potash 1.40%

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agric. Chem. Co. (Continued)				
Bradley's Eclipse Phosphate for All Crops	Millis		470	
" " " " " "	Amesbury	$14.24	528	8.27
" " " " " "	Danvers		779	
Bradley's English Lawn Fertilizer	Amesbury	25.51	527	6.08
Bradley's Green Mountain Special	Beverly	18.16	655	7.90
Bradley's High Grade Fertilizer with 10% Potash	New Bedford	24.19	253	9.49
" " " " " " "	Amesbury		443	
Bradley's High Grade Fertilizer with 10% Potash	Leominster	24.31	919	8.79
Bradley's High Grade Potato and Root Special	Beverly	21.61	668	8.76
Bradley's Niagara Phosphate	Plymouth	13.49	462	7.94
" " "	Brookfield		1147	
Bradley's Potato Fertilizer	Amherst		50	
" " "	Millis	18.25	432	11.94
" " "	Whitman		447	
" " "	Rockland		452	
Bradley's Potato Fertilizer	E. Longmeadow	18.07	1007	12.20
Bradley's Potato Manure	New Bedford		252	
" " "	Plymouth	20.27	463	10.16
" " "	Millis		469	
Bradley's Potato Manure	E. Longmeadow	19.71	1006	9.45
Bradley's XL Superphosphate of Lime	Amherst		49	
" " " " " "	Sunderland		191	
" " " " " "	Sunderland	20.44	195	12.12
" " " " " "	New Bedford		251	
Bradley's XL Superphosphate of Lime	Plymouth		457	
" " " " " "	Millis	19.75	468	9.75
" " " " " "	E. Longmeadow		1009	
Clark's Cove Bay State Fertilizer	Oakdale	19.63	1139	10.34
Clark's Cove Bay State Fertilizer G. G.	Concord	16.91	423	7.85
" " " " " "	Oakdale		985	
Clark's Cove Great Planet Manure A. A.	Spencer	26.64	1087	10.66
" " " " " "	Oakdale		1148	
Clark's Cove Potato Fertilizer	Concord	17.52	431	9.74
" " " "	Cushman		734	
Clark's Cove Potato Fertilizer	Spencer	18.52	1157	12.01
Clark's Cove Potato Manure	Oakdale	21.56	957	7.49
Darling's Blood, Bone and Potash	E. Pepperell		1017	
" " " " "	Palmer	28.42	1113	9.72
" " " " "	Worcester		1167	
Darling's Complete 10% Manure	N. Amherst	27.00	160	7.55
" " " "	S. Amherst		709	
Darling's Complete 10% Manure	Barre Plains	28.44	956	9.30
Darling's Farm Favorite	Billerica		589	
" " "	Taunton	17.96	707	10.24
" " "	S. Amherst		710	
Darling's Farm Favorite	Worcester	18.09	1168	10.45
Darling's General Fertilizer	E. Pepperell	13.70	1020	9.09

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.35	.38	.26	.31	1.30	1.03	3.55	4.21	2.14	9.90	9.00	7.76	8.00	2.23	2.00
4.33	—	.05	.04	4.42	4.94	1.82	2.39	.71	4.92	5.00	4.21	4.00	6.26	6.00
.79	.29	.42	.27	1.77	1.65	4.34	3.44	.89	8.67	9.00	7.78	8.00	5.29	5.00
1.43	.31	.45	.31	2.50	2.47	3.64	2.74	1.58	7.96	7.00	6.38	6.00	10.27	10.00
1.51	.31	.45	.35	2.62	2.47	4.21	2.11	1.38	7.70	7.00	6.32	6.00	9.96	10.00
.73	.26	.40	.21	1.60	1.65	5.52	3.38	1.05	9.95	9.00	8.90	8.00	8.84	10.00
.68	.12	.30	.23	1.33	.82	5.27	2.13	.87	8.27	8.00	7.40	7.00	2.01	1.00
.91	.39	.43	.34	2.07	2.06	5.32	2.77	1.66	9.75	9.00	8.09	8.00	3.29	3.00
.82	.52	.35	.34	2.03	2.00	4.34	3.77	1.28	9.39	9.00	8.11	8.00	3.53	3.00
1.38	.30	.47	.31	2.46	2.47	4.69	2.10	1.25	8.04	7.00	6.79	6.00	5.48	5.00
1.36	.45	.37	.30	2.48	2.47	4.18	2.18	1.22	7.58	7.00	6.36	6.00	5.21	5.00
1.30	.36	.44	.37	2.47	2.47	6.03	3.31	1.68	11.02	10.00	9.34	9.00	2.86	2.00
1.22	.48	.41	.34	2.45	2.47	6.22	2.84	1.53	10.59	10.00	9.06	9.00	2.46	2.00
1.22	.48	.43	.34	2.47	2.47	5.55	3.33	1.45	10.33	10.00	8.88	9.00	2.52	2.00
1.06	.30	.37	.27	2.00	2.06	5.42	3.07	1.15	9.64	9.00	8.49	8.00	1.90	1.50
1.84	.24	.71	.43	3.22	3.29	4.31	3.83	1.63	9.77	9.00	8.14	8.00	8.24	7.00
1.02	.38	.29	.28	1.97	2.06	4.25	3.43	1.96	9.64	9.00	7.68	8.00	3.28	3.00
1.01	.12	.56	.47	2.16	2.06	4.97	3.02	1.35	9.34	9.00	7.99	8.00	3.51	3.00
1.20	.40	.62	.37	2.59	2.47	4.27	2.92	1.33	8.52	7.00	7.19	6.00	6.03	5.00
1.75	.42	1.33	.50	4.00	4.11	4.50	3.07	1.38	8.95	8.00	7.57	7.00	7.44	7.00
1.80	.22	.88	.45	3.35	3.29	3.06	3.32	1.22	7.60	7.00	6.38	6.00	10.06	10.00
1.57	.78	.74	.47	3.56	3.29	2.93	3.39	1.84	8.16	7.00	6.32	6.00	10.56	10.00
1.13	.14	.45	.38	2.10	2.06	4.89	2.89	1.48	9.26	9.00	7.78	8.00	3.28	3.00
.89	.50	.41	.32	2.12	2.06	4.50	3.31	2.14	9.95	9.00	7.81	8.00	3.02	3.00
.16	.52	.35	.30	1.33	1.23	3.13	3.12	2.25	8.50	7.00	6.25	6.00	2.87	3.00

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agric. Chem. Co. (Continued)				
Darling's Potato Manure	N. Amherst		161	
” ” ”	Sunderland	$20.77	281	8.96
” ” ”	Sunderland		282	
Darling's Potato Manure	S. Amherst	19.62	735	8.40
Darling's Potato and Root Crop Manure	N. Amherst	27.76	99	10.41
” ” ” ” ” ” ”	N. Amherst		177	
Darling's Potato and Root Crop Manure	Taunton	26.13	745	10.21
Farquhar's Lawn and Garden Dressing	Boston	30.06	571	5.71
Farquhar's Vegetable and Potato Fertilizer	Boston	25.13	568	8.79
” ” ” ” ”	Boston		569	
Great Eastern Garden Special	Pepperell	25.63	943	11.80
” ” ” ”	E. Longmeadow		961	
Great Eastern Garden Special	N. Brookfield	25.64	1164	10.78
Great Eastern General Fertilizer	S. Athol	14.17	1174	11.85
Great Eastern Northern Corn Special	Southwick		1046	
” ” ” ” ”	E. Wilbraham	20.11	1116	9.97
” ” ” ” ”	N. Brookfield		1155	
Great Eastern Vegetable, Vine and Tobacco	Chelmsford		598	
” ” ” ” ” ”	Pratts Junction	20.86	1045	11.38
” ” ” ” ” ”	Southwick		1047	
Great Eastern Vegetable, Vine and Tobacco	N. Brookfield	21.43	1165	8.59
Pacific High Grade General Fertilizer	Wayland	26.20	1095	7.26
” ” ” ” ”	S. Sudbury		1097	
Pacific Potato Special	Newburyport	18.23	440	12.07
Soluble Pacific Guano	Newburyport	16.30	441	11.21
Packer's Union Animal Corn Fertilizer	New Bedford		261	
” ” ” ” ”	Amherst	20.17	799	11.18
” ” ” ” ”	Mendon		897	
Packer's Union Gardener's Complete Manure	Concord		396	
” ” ” ” ”	Amherst		817	
” ” ” ” ”	Mendon	26.12	892	7.28
” ” ” ” ”	E. Longmeadow		962	
” ” ” ” ”	Southwick		1049	
Packer's Union Potato Manure	Amherst	20.91	800	10.59
” ” ” ”	Mendon		899	
Packer's Union Universal Fertilizer	Concord	14.09	425	10.47
Quinnipiac Corn Phosphate	Pittsfield	16.79	1200	9.57
Quinnipiac Market Garden Manure	Fall River		331	
” ” ” ”	Billerica	26.14	590	9.96
” ” ” ”	N. Amherst		732	
Quinnipiac Phosphate	Billerica	19.65	591	10.96
Quinnipiac Potato Manure	Billerica	20.84	663	10.57
Quinnipiac Potato Phosphate	Fall River	17.87	330	10.28
” ” ”	N. Amherst		731	
Read's Farmers' Friend Superphosphate	S. Deerfield		127	
” ” ” ” ”	Sunderland		164	
” ” ” ” ”	Sunderland	18.87	199	11.48
” ” ” ” ”	Sunderland		207	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.25	.47	.53	.28	2.53	2.47	4.38	2.45	1.33	8.16	7.00	6.83	6.00	5.70	5.00
1.31	.26	.60	.30	2.47	2.47	3.10	2.87	1.10	7.07	7.00	5.97	6.00	5.68	5.00
1.57	.84	.65	.37	3.43	3.29	5.42	2.72	2.17	10.31	9.00	8.14	8.00	8.18	7.00
1.74	.48	.65	.42	3.29	3.29	4.59	3.40	1.53	9.52	9.00	7.99	8.00	7.46	7.00
1.63	.28	.70	.45	3.06	3.30	.51	9.32	9.36	19.19	14.00	9.83	4.00	8.16	7.00
1.65	.41	.58	.36	3.00	3.00	5.68	2.38	1.79	9.85	7.00	8.06	6.00	7.25	7.00
1.89	.30	.44	.43	3.06	3.29	6.06	2.41	1.22	9.69	9.00	8.47	8.00	7.44	7.00
1.85	.40	.70	.32	3.27	3.29	4.72	3.26	1.38	9.36	9.00	7.98	8.00	7.03	7.00
.19	.19	.25	.20	.83	.82	5.40	2.94	1.28	9.62	9.00	8.34	8.00	3.91	4.00
1.38	.35	.44	.38	2.55	2.47	6.03	3.05	1.94	11.02	9.00	9.08	8.00	2.23	2.00
1.03	.26	.40	.37	2.06	2.06	5.74	2.37	1.61	9.72	9.00	8.11	8.00	6.39	6.00
1.10	.46	.37	.23	2.16	2.06	4.31	3.60	1.63	9.54	9.00	7.91	8.00	6.96	6.00
2.08	—	.99	.28	3.35	3.29	3.83	4.10	1.51	9.44	9.00	7.93	8.00	7.46	7.00
1.09	.16	.49	.38	2.12	2.06	4.82	3.37	1.25	9.44	9.00	8.19	8.00	3.24	3.00
.85	.59	.29	.29	2.02	2.06	4.46	3.24	1.71	9.41	9.00	7.70	8.00	1.67	1.50
1.29	.32	.47	.46	2.54	2.47	6.48	2.75	1.51	10.74	9.00	9.23	8.00	2.38	2.00
1.50	.23	.45	.36	2.54	2.47	4.02	2.31	1.76	8.09	7.00	6.33	6.00	10.29*	10.00
.93	.30	.56	.29	2.08	2.06	5.78	2.49	1.99	10.26	9.00	8.27	8.00	6.01	6.00
.12	.34	.25	.17	.88	.82	4.72	3.29	1.17	9.18	9.00	8.01	8.00	4.01	4.00
1.01	.16	.57	.34	2.08	2.06	4.53	3.15	2.35	10.03	9.00	7.68	8.00	1.69	1.50
1.97	.38	.50	.41	3.26	3.29	5.46	2.63	1.84	9.93	9.00	8.09	8.00	7.29	7.00
1.37	.27	.48	.36	2.48	2.47	6.35	2.81	1.63	10.79	10.00	9.16	9.00	2.05	2.00
1.62	.20	.41	.32	2.55	2.47	4.91	2.36	1.40	8.67	7.00	7.27	6.00	5.23	5.00
.81	.22	.46	.42	1.91	2.06	5.27	2.76	2.17	10.20	9.00	8.03	8.00	3.38	3.00
1.00	.55	.38	.29	2.22	2.06	5.42	2.95	1.45	9.82	9.00	8.37	8.00	3.19	3.00

* No. 396–817–892–962–1049 Chlorine 1.34% equivalent to 1.77% potash, 8.52% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agric. Chem. Co. (Continued)				
Read's High Grade Farmers' Friend Superphosphate	Easthampton. .	$26.61	1219	8.80
Read's Practical Potato Special Fertilizer.	Sunderland. . . .	15.82	198	6.45
" " " " "	Amherst.		653	
Read's Standard Superphosphate	S. Deerfield. . . .	14.13	123	9.35
" " " "	Sunderland. . . .		492	
Read's Standard Superphosphate	W. Upton.	14.41	929	9.79
Read's Vegetable and Vine Fertilizer.	S. Deerfield. . . .	21.88	129	8.43
" " " " "	Amherst.		652	
Read's Vegetable and Vine Fertilizer.	S. Barre.	20 75	958	12.58
Standard Complete Manure.	Northboro.	26.58	1239	10.56
Standard Fertilizer.	Whitman.	16.73	445	11.94
" "	Upton.		928	
" "	N. Leominster .		971	
Standard Guano for All Crops.	Upton.	12.96	930	10.77
" " " " "	Spencer.		1158	
Standard Special for Potatoes.	Whitman.	18.11	444	11.44
" " " "	Upton.		920	
" " " "	N. Leominster .		973	
Standard Special for Potatoes.	Conway.	18.17	1177	10.49
Wheeler's Connecticut Tobacco Grower.	Southwick	28.84	1039	7.36
Wheeler's Corn Fertilizer.	Chelmsford. . . .	15.73	597	13.29
" " "	Pepperell.		894	
" " "	Southwick.		1050	
Wheeler's Havana Tobacco Grower.	Danvers.	27.11	763	6 85
" " " "	Southwick.		1048	
Wheeler's Havana Tobacco Grower.	E. Wilbraham	26 20	1110	8 31
Wheeler's Potato Manure.	Danvers.	18.17	765	12.09
" " "	Pepperell.		942	
Wheeler's Potato Manure.	Agawam	18.17	1117	11.36
Williams and Clark Americus Corn Phosphate	Hamilton.	17.12	661	11 53
" " " " " "	Norwood.		901	
Williams and Clark Americus Corn Phosphate.	Worcester.	17.13	1166	8.49
" " " " " " "	Wilkinsonville .		1217	
Williams and Clark Americus High Grade Special Fertilizer for Potatoes and Vegetables.	Hamilton.	25.96	660	11.30
Williams and Clark Americus High Grade Special Fertilizer for Potatoes and Vegetables.	Norwood.		905	
Williams and Clark Americus Potato Manure.	Norwood.	18.50	859	14.30
" " " " " "	Worcester.		1026	
Williams and Clark Americus Potato Manure.	Brockton.	18 26	1159	10.09
" " " " " "	Wilkinsonville .		1218	
Williams and Clark Potato Phosphate.	Hamilton.	19.81	657	9 33
Williams and Clark Prolific Crop Producer.	Worcester.	11 36	1024	8 97
" " " " " "	Brockton.		1172	
Williams and Clark Roy. Bone Phos. for all Crops. . .	Brockton.	15 61	1160	10 05
Armour Fertilizer Works, Baltimore, Md.				
All Soluble.	Taunton.	21.82	263	7.93
" "	Brockton.		693	
Ammoniated Bone with Potash.	Middleboro . . .	19 69	691	7.13
" " " "	S. Framingham		989	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
2.26	.21	.43	.26	3.16	3.29	3.35	2.90	1.58	7.83	7.00	6.25	6.00	10.43	10.00
.51	.18	.18	.21	1.08	.82	2.87	1.57	.87	5.31	5.00	4.44	4.00	8.91	8.00
.32	.16	.19	.17	.84	.82	5.27	2.84	1.38	9.49	9.00	8.11	8.00	4.01	4.00
.30	.21	.23	.20	.94	.82	4.66	3.15	1.22	9.03	9.00	7.81	8.00	4.32	4.00
1.05	.36	.48	.33	2.22	2.06	5.84	2.40	1.45	9.69	9.00	8.24	8.00	6.80	6.00
1.12	.26	.46	.36	2.20	2.06	5.59	2.70	1.86	10.15	9.00	8.29	8.00	5.39	6.00
2.13	.26	.67	.30	3.36	3.29	3.67	4.42	1.91	10.00	9.00	8.09	8.00	7.56	7.00
.76	.51	.39	.37	2.03	2.06	4.63	3.20	1.99	9.82	9.00	7.83	8.00	1.84	1.50
.36	.18	.25	.23	1.02	1.03	4.46	3.22	1.56	9.28	9.00	7.68	8.00	2.25	2.00
1.03	.24	.48	.33	2.08	2.06	5.20	2.58	1.89	9.67	9.00	7.78	8.00	3.31	3.00
1.10	.29	.42	.28	2.09	2.06	4.95	3.03	1.66	9.64	9.00	7.98	8.00	3.31	3.00
.26	.24	2.60	1.43	4.53	4.53	.55	5.75	.18	6.48	3.00	6.30	3.00	6.22*	5.50
.87	.24	.28	.27	1.66	1.64	4.76	3.17	1.89	9.82	9.00	7.93	8.00	2.27	2.00
1.45	.29	.42	.35	2.51	2.47	4.66	2.82	1.30	8.78	7.00	7.48	6.00	10.46*	10.00
1.43	.30	.48	.32	2.53	2.47	3.55	2.57	2.63	8.75	7.00	6.12	6.10	10.31*	10.00
1.02	.23	.45	.41	2.11	2.06	4.91	2.69	1.79	9.39	9.00	7.60	8.00	3.49	3.00
1.22	.06	.56	.29	2.13	2.06	5.08	3.13	1.33	9.54	9.00	8.21	8.00	3.06	3.00
.84	.41	.49	.35	2.09	2.06	5.20	2.81	2.12	10.13	9.00	8.01	8.00	1.74	1.50
1.10	.37	.43	.26	2.16	2.06	4.63	3.25	1.53	9.41	9.00	7.88	8.00	1.94	1.50
2.16	.30	.45	.30	3.21	3.29	5.56	2.35	1.96	9.87	9.00	7.91	8.00	7.44	7.00
.96	.39	.43	.33	2.11	2.06	5.36	2.68	1.86	9.90	9.00	8.04	8.00	3.39	3.00
.86	.47	.42	.31	2.06	2.06	4.97	3.19	1.99	10.15	9.00	8.16	8.00	3.18	3.00
1.59	.20	.37	.27	2.43	2.47	4.88	1.83	1.17	7.88	7.00	6.71	6.00	5.20	5.00
.65	.02	.18	.17	1.02	.82	4.66	2.33	1.12	8.11	8.00	6.99	7.00	1.22	1.00
.58	.24	.41	.23	1.46	1.03	4.53	3.43	1.71	9.67	9.00	7.96	8.00	3.08	2.00
1.24	.28	.88	.45	2.85	2.88	5.29	2.72	1.25	9.26	8.50	8.01	8.00	4.32	4.00
.74	.32	1.20	.84	3.10	2.47	3.19	3.32	1.30	7.81	6.50	6.51	6.00	2.27	2.00

* No. 1039 Chlorine .20% equivalent to .28% potash, 5.94% potash as sulfate.
" 763–1048 " .92% " " 1.22% " 9.24% " " "
" 1110 " 1.52% " " 2.02% " 8.29% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Armour Fertilizer Works (Continued)				
Bone, Blood and Potash	Amherst	$30.87	43	7.28
" " " "	N. Hadley		144	
" " " "	N. Hadley		155	
Bone, Blood and Potash	Seekonk	30 32	402	7.96
" " " "	Middleboro		689	
Complete Potato	Brockton	19 36	686	7.69
" "	Middleboro		705	
" "	Norwood		883	
" "	S. Framingham		991	
" "	Hudson		1101	
Connecticut Valley Tobacco Grower	Amherst	30.19	48	8.24
" " " "	N. Hadley		112	
" " " "	N. Hadley		140	
" " " "	N. Hadley		145	
" " " "	N. Hadley		227	
Fish and Potash	Taunton	19.69	262	5.57
" " "	Brockton		700	
Fruit and Root Crop Special	Brockton	17 69	701	7.58
Grain Grower	Brockton	16 66	699	6.90
" "	Middleboro		706	
" "	Norwood		909	
" "	S. Framingham		995	
" "	Hudson		1099	
High Grade Potato	Amherst	22 96	45	8.05
" " "	N. Hadley		133	
" " "	Taunton		274	
" " "	Seekonk		361	
High Grade Potato	Brockton	23.46	692	7 22
" " "	Middleboro		702	
" " "	Hudson		1100	
Market Garden	Seekonk	26 23	386	8 28
" "	Brockton		687	
" "	Middleboro		688	
Onion Special	Amherst	30 93	44	8.88
" "	N. Hadley		150	
" "	Seekonk		389	
Atlantic Fertilizer Co, Baltimore, Md.				
Garden Fertilizer	Bridgewater	20 25	1221	6 09
Potato Fertilizer	Bridgewater	25.73	1231	6.87
Beach Soap Co., Lawrence, Mass.				
Advance	Lawrence	26.61	552	8.22
Advance	Lynn	26 23	609	6.68
Lawn Dressing	Lawrence	28 83	551	2 24
Lawn Dressing	Lynn	27 85	610	6 93
Market Garden Fertilizer	Lawrence	34 79	555	10 33
Reliance	Lawrence	21 12	558	10.33
Reliance	Lynn	21 51	611	5 54

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
2.29	.61	1.00	.56	4.46	4.11	6.03	2.57	—	8.60	8.50	8.60	8.00	7.83	7.00
2.68	.15	1.06	.49	4.38	4.11	7.78	.74	.51	9.03	8.50	8.52	8.00	7.23	7.00
.37	.19	.71	.51	1.78	1.65	4.78	2.57	1.17	8.52	7.50	7.35	7.00	6.82	6.00
1 26	27	2.20	1.45	5 18	4.52	2.61	1.73	.33	4.67	4.50	4.34	4.00	6.55*	5.50
.38	.34	1.22	.74	2.68	2.05	3.70	2.43	.99	7.12	6.50	6.13	6.00	4.55	2.00
.31	.20	.64	.43	1.58	1.65	6.61	1.99	.56	9.16	8.50	8.60	8.00	4.65	5.00
.28	.42	.65	.47	1.82	1.65	5.01	2.97	1.84	9.82	8.50	7.98	8.00	2.52	2.00
.22	13	.72	56	1.63	1.65	5.26	3.44	.51	9.21	8.50	8.70	8.00	10.72	10.00
.41	09	.69	68	1.87	1.65	5.61	2.61	1.22	9.44	8.50	8.22	8.00	10.31	10.00
1.25	.28	.84	.76	3 13	3.29	6.70	1.64	1.61	9.95	8.50	8.34	8.00	7.62	7.00
80	39	.86	.43	2 48	2.47	11.86	2.15	.71	14.72	12.50	14.01	12.00	10.50	10.00
.25	1 70	.26	.29	2.50	2.47	5 20	3.09	.41	8.70	9.00	8.29	8.00	4.07	4.00
.85	1.25	.54	.47	3.11	3 29	5 33	3.04	.56	8.93	9.00	8.37	8.00	7.71	7.00
.16	1.53	.54	.79	3.02	2 50	2 91	5.16	3.21	11.28	10.00	8.07	8.00	6.96*	6.00
.47	1.16	.68	67	2.98	2 50	2.81	5.13	3.44	11.38	10.00	7.94	8.00	6.80*	6.00
3 68	.18	.09	.15	4.10	4 00	3.89	2.69	3.11	9.69	9.50	6.58	7.50	7.73*	5.25
3 59	.13	.15	.15	4 02	4.00	3 60	3.46	2.81	9.87	9.50	7.06	7.50	6.84	5.25
2.51	1.19	.56	.54	4.80	4 74	.68	6.97	.77	8.42	8.00	7.65	7.00	10.19*	9.75
.29	.76	.71	.70	2.46	1 65	2.61	4.99	4.59	12.19	10.00	7.60	8.00	4.26	3.00
.66	.72	.55	.64	2.56	1.65	3.00	4.30	4.36	11.66	10.00	7.30	8.00	4.67	3.00

* Nos. 48–112–140–145–227 Chlorine .40% equivalent to .52% potash, 6.03% potash as sulfate.
No. 552 " .69% " " .92% " 6.04% " " "
" 609 " .75% " " 1.00% " 5.80% " " "
" 551 " 5.29% " " 7.03% " .70% " " "
" 555 " 1.34% " " 1.76% " 8.43% " " "

Another sample of the Beach's Market Garden Fertilizer sent on by the manufacturer and said to be a representative one tested .74% Chlorine, equivalent to .97% potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Beach Soap Co., (Concluded)				
Seeding Down	Lawrence	$31.81	561	3.91
Seeding Down	Lynn	30.38	607	6.19
Top Dressing	Lawrence	43.82	554	2.99
Berkshire Fertilizer Co., Bridgeport, Conn.				
Berkshire Ammoniated Bone Phosphate	Upton	15.31	927	8.14
Berkshire Complete Fertilizer	N. Hadley		104	
" " "	N. Hadley	25.87	111	7.73
" " "	Westfield		1042	
Berkshire Complete Tobacco Fertilizer	Bradstreet		71	
" " " "	Hatfield	24.99	87	9.03
" " " "	N. Hadley		116	
Berkshire Complete Tobacco Fertilizer	Bradstreet		128	
" " " "	N. Hadley		142	
" " " "	N. Hadley	25.62	147	10.98
" " " "	N. Hadley		164	
Berkshire Comp. Tobacco Fertilizer	Hadley	27.14	1291	8.64
Berkshire Cowls Special Mixture	N. Amherst	33.73	323	7.10
Berkshire Economical Grass Fertilizer	N. Hadley		105	
" " " "	N. Hadley		109	
" " " "	N. Hadley	43.78	125	3.60
" " " "	N. Hadley		231	
Berkshire Fish and Potash	N. Hadley	20.97	110	13.93
" " " "	N. Hadley		503	
Berkshire Grass Special	Westfield	26.74	1083	7.84
Berkshire Long Island Special	Sunderland		53	
" " " "	N. Hadley	26.91	115	8.34
" " " "	Seekonk		385	
Berkshire Potato and Vegetable Phosphate	Upton	19.10	931	9.77
Berkshire Tobacco Special with Carbonate of Potash	N. Hadley		108	
" " " " " " "	N. Hadley		113	
" " " " " " "	N. Hadley	30.76	131	12.50
" " " " " " "	Sunderland		181	
Berkshire Tobacco Special with Carbonate of Potash	Hadley	29.91	1290	9.31
C. M. Bolles, Pepperell, Mass.				
Nissitissitt Plant Food	Pepperell	34.38	937	3.53
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Pulverized Sheep Manure	Newburyport		439	
" " " "	Boston		547	
" " " "	Beverly	13.71	643	15.46
" " " "	Springfield		844	
Bowker's Ammoniated Food for Flowers	Boston	20.99	531	4.14
Bowker's Bone and Wood Ash Fertilizer	Plymouth		458	
" " " " " "	Springfield		846	
" " " " " "	Leominster	15.66	890	9.29
" " " " " "	S. Framingham		990	

* No. 937 Chlorine .63% equivalent to .84% potash, 12.94% potash as sulfate.
** Potash figured at 5c per pound.
* 1291 Chlorine 1.45% equivalent to 1.92% potash, 4.43% potash as sulfate.
* 1290 Chlorine 1.46% equivalent to 1.91% potash, 3.23% potash as carbonate.
*No. 531 Chlorine 2.03% equivalent to 2.69% potash, 1.51% potash as sulphate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.06	.97	.79	.61	2.43	1.85	.57	6.50	7.70	14.77	14.00	7.07	5.00	16.22	14.50
.30	.59	.78	.60	2.27	1.85	.77	7.21	7.17	15.15	14.00	7.98	5.00	14.65	14.50
5.13	.58	.47	.35	6.53	5.35	.38	4.98	2.70	8.06	7.00	5.36	4.00	16.61	15.00
.19	.21	.51	.41	1.32	.80	6.44	1.73	.48	8.65	9.00	8.17	8.00	3.47	2.00
.90	.84	.79	.55	3.08	2.50	7.25	1.66	.43	9.34	9.00	8.91	8.00	7.33	6.00
.59	.33	1.15	.64	2.71	2.50	5.56	3.00	.71	9.26	9.00	8.55	8.00	6.95*	6.00
.60	.08	1.42	.75	2.85	2.50	3.48	5.17	2.22	10.87	9.00	8.65	8.00	6.71*	6.00
.80	14	1.61	.56	3.11	2.50	5.52	4.38	1.63	11.53	9.00	9.90	8.00	6.35*	6.00
2.69	.76	.53	.42	4.40	4.00	5.36	2.62	.36	8.34	—	7.98	7.00	7.94*	8.00
6.78	.43	.89	.22	8.32	8.00	Trace	4.36	3.07	8.06	8.00	4.36	4.00	9.26	8.00
.29	.04	1.74	.82	2.89	2.50	1.34	5.99	.20	7.53	6.00	7.33	4.00	4.63	3.00
3.12	22	1.11	.74	5.19	5.00	3.54	1.74	.38	5.66	5.00	5.28	4.00	3.06	2.00
1.12	28	1.24	.90	3.54	3.30	4.63	2.36	1.71	8.70	7.00	6.99	6.00	8.04	7.00
.38	09	1.36	.57	2.40	1.70	2.65	3.99	.20	6.84	7.00	6.64	6.00	5.12	4.00
.60	.56	2.28	1.63	5.07	4.50	.60	3.94	.41	4.95	4.00	4.54	3.00	5.70*	5.50
.38	1.60	2.07	1.18	5.23	4.50	1.12	2.68	.05	3.85	4.00	3.80	3.00	5.22*	5.50
1.88	.32	.42	.34	2.96	4.00	2.97	6.49	2.91	12.37	10.00	9.46	4.50	13.78*	10.00
—	.58	59	1.18	2.35	1.23	.96	1.59	.38	2.93	1.50	2.55	—	2.38**	2.00
2.51	.23	04	.04	2.82	2.47	.09	7.34	1.73	9.16	7.00	7.43	6.00	4.20*	2.00
77	.31	41	.30	1.97	1.65	3.51	3.20	1.58	8.29	7.00	6.71	6.00	3.04	2.00

* Nos. 71–87–116 Chlorine .84% equivalent to 1.12% potash, 5.83% potash as sulfate.
" 128–142–147–164 " 1.36% " " 1.80% " 4.91% " " "
" 323 " .82% " " 1.07% " 8.87% " " "
" 108–113–131–181 " .91% " " 1.20% " .97% " " "
3.53% potash as carbonate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Bowker Fertilizer Co. (Continued)				
Bowker's Complete Alkaline Tobacco Grower	Easthampton	$25.72	224	6.78
Bowker's Corn Phosphate	Dighton	16.04	315	10.45
" " "	Norwood		907	
Bowker's Early Potato Manure	Concord		436	
" " " "	Montague		638	
" " " "	S. Framingham	26.96	992	10.68
" " " "	N. Brookfield		1163	
Bowker's Farm and Garden Phosphate	Bridgewater		695	
" " " " "	Springfield	16.47	847	9.84
" " " " "	Wrentham		865	
Bowker's Fish and Potash Square Brand	Easthampton	18.09	221	8.97
" " " " " "	Northampton		670	
Bowker's Gloucester Fish and Potash	Taunton	12.54	743	9.83
" " " " "	Wrentham		866	
Bowker's Grain and Grass Fertilizer	Natick		614	
" " " " "	Springfield	21.05	841	9.50
" " " " "	Leominster		888	
Bowker's High Grade Fertilizer	Beverly	20.80	667	9.96
" " " "	Leominster		884	
Bowker's Highly Nitrogenized Mixture	Leverett	44.96	1059	5.79
Bowker's Hill and Drill Phosphate	Dighton		316	
" " " " "	Concord		437	
" " " " "	Rockland	19.44	455	11.43
" " " " "	Plymouth		459	
" " " " "	S. Weymouth		529	
Bowker's Hill and Drill Phosphate	Montague	20.19	639	11.71
Bowker's Lawn and Garden Dressing	Newburyport		438	
" " " " "	Boston	21.29	546	6.28
" " " " "	Springfield		845	
Bowker's Market Garden Fertilizer	Boston		572	
" " " "	Natick		618	
" " " "	Northampton	24.35	792	8.11
" " " "	Springfield		858	
" " " "	Leominster		889	
Bowker's Onion Fertilizer	Hatfield		89	
" " "	Montague	27.54	642	7.33
" " "	Northampton		791	
Bowker's Potato and Vegetable Fertilizer	Concord	19.89	429	13.39
" " " " "	Plymouth		465	
Bowker's Potato and Vegetable Fertilizer	Natick	21.51	615	10.54
" " " " "	Wrentham		864	
Bowker's Potato and Vegetable Phosphate	Dighton	16.27	314	9.34
" " " " "	Bridgewater		694	
Bowker's Soluble Animal Fertilizer	Fall River	20.39	294	9.19
" " " "	Dighton		328	
Bowker's Sure Crop Phosphate	Rockland	13.67	453	10.86
" " " "	Leominster		891	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.20	.36	2.16	1.39	4.11	4.11	.74	5.02	.03	5.79	5.00	5.76	4.00	5.35*	5.00
1.04	.16	.31	.17	1.68	1.65	5.36	3.06	1.20	9.62	9.00	8.42	8.00	2.36	2.00
2.18	.40	.52	.30	3.40	3.29	4.85	3.55	1.68	10.08	9.00	8.40	8.00	7.50	7.00
1.04	.28	.32	.19	1.83	1.65	5.17	2.87	1.35	9.39	9.00	8.04	8.00	2.50	2.00
.85	.27	.84	.55	2.51	2.47	1.98	2.59	1.94	6.51	5.00	4.57	4.00	4.71	4.00
.52	.21	.18	.12	1.03	.82	5.40	2.82	.99	9.21	9.00	8.22	8.00	1.36	1.00
1.33	.34	.48	.29	2.44	2.47	5.46	3.19	1.20	9.85	9.00	8.65	8.00	4.67	4.00
1.35	.42	.44	.29	2.50	2.47	4.78	3.56	1.76	10.10	9.00	8.34	8.00	4.21	4.00
6.64	.23	.94	.45	8.26	8.23	1.53	6.78	.87	9.18	8.00	8.31	7.00	8.33	8.00
1.19	.22	.53	.35	2.29	2.47	6.44	2.72	1.53	10.69	10.00	9.16	9.00	2.67	2.00
1.43	.26	.46	.34	2.49	2.47	6.44	3.05	1.48	10.97	10.00	9.49	9.00	2.40	2.00
3.27	.04	.04	.03	3.38	3.29	1.85	2.15	.59	4.59	5.00	4.00	4.00	6.05	5.00
1.46	.33	.52	.29	2.60	2.47	3.83	2.67	1.33	7.83	7.00	6.50	6.00	10.00	10.00
1.67	.15	.38	.27	2.47	2.47	7.14	3.07	1.86	12.07	11.00	10.21	10.00	8.43*	8.00
1.55	.31	.30	.25	2.41	2.47	5.49	2.75	1.53	9.77	9.00	8.24	8.00	3.68	4.00
1.46	.33	.36	.35	2.50	2.47	5.49	3.33	1.28	10.10	9.00	8.82	8.00	4.77	4.00
1.06	.24	.31	.16	1.77	1.63	5.36	3.00	1.10	9.46	9.00	8.36	8.00	2.34	2.00
1.20	.44	.45	.36	2.45	2.47	5.00	3.17	1.81	9.98	9.00	8.17	8.00	4.05	4.00
.26	.23	.34	.25	1.08	.82	4.55	3.43	1.71	9.69	9.00	7.98	8.00	2.44	2.00

* No. 224 Chlorine .74% equivalent to .98% potash, 4.37% potash as sulfate.
" 89-642-791 " .62% " " .82% " 7.61% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Bowker Fertilizer Co. (Concluded)				
Stockbridge Sp. Com. Man for Corn & all Gr. Crops	Dighton		304	
" " " " " " " " "	Taunton		321	
" " " " " " " " "	S. Weymouth	$27.21	506	9.88
" " " " " " " " "	Natick		616	
" " " " " " " " "	Montague		641	
" " " " " " " " "	Bridgewater		711	
Stockbridge Sp. Com. Man. for Corn and all Gr. Crops	Wrentham	28.07	863	10.64
Stockbridge Sp. Com. Man, for Potatoes and Veg.	Easthampton		226	
" " " " " " " "	Fall River		295	
" " " " " " " "	Dighton	27.19	305	7.87
" " " " " " " "	Taunton		327	
Stockbridge Sp. Com. Man. for Potatoes and Veg.	Rockland		450	
" " " " " " " "	Plymouth		456	
" " " " " " " "	Natick	26.79	617	7.85
" " " " " " " "	Montague		640	
" " " " " " " "	Middleboro		704	
Stockbridge Sp. Com. Manure for Seeding Down Perm. Dress. and Legumes	Dighton		313	
Stockbridge Sp. Com. Manure for Seeding Down Perm. Dress. and Legumes	Concord	28.07	421	9.01
Stockbridge Sp. Com. Manure for Seeding Down Perm. Dress. and Legumes	S. Weymouth		507	
Stockbridge Tobacco Manure	Deerfield	36.71	1184	5.96
Stockbridge Sp. Com. Man. for Top Dress. and Forc.	Dighton		316	
" " " " " " " " "	Rockland		451	
" " " " " " " " "	Plymouth	26.86	461	6.97
" " " " " " " " "	S. Weymouth		505	
Stockbridge Sp. Com. Man. for Top Dress. and for Forc.	Chelmsford		599	
" " " " " " " " " "	Montague		637	
" " " " " " " " " "	Beverly	26.75	654	6.93
" " " " " " " " " "	Middleboro		703	
Joseph Breck & Sons, Corp., Boston, Mass.				
Breck's Lawn and Garden Dressing	Boston	23.37	478	9.05
Breck's Market Garden Manure	Boston	19.75	517	12.88
Breck's Ram's Head Brand Pulverized Sheep Manure	Boston	11.99	868	5.06
The E. D. Chittenden Co., Bridgeport, Ct.				
Chittenden's Connecticut Tobacco Grower	Leverett	32.02	820	7.54
Chittenden's Grain and Vegetable	Montague		636	
" " " "	S. Acton		936	
" " " "	Charlton	23.48	974	9.18
" " " "	Southbridge		1028	
" " " "	Mittineague		1136	
Chittenden's Grass and Grain	Leverett		816	
" " " "	Charlton	28.49	997	9.25
" " " "	Southbridge		1143	
Chittenden's Potato and Grain	Leominster		915	
" " " "	S. Acton	25.52	933	8.53
" " " "	Charlton		1010	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
2.39	.11	.43	.32	3.25	3.29	6.63	2.43	1.68	10.74	11.00	8.06	10.00	7.67	7.00
2.25	.29	.64	.18	3.36	3.29	6.29	3.41	1.63	11.33	11.00	9.70	10.00	7.62	7.00
1.85	.41	.61	.43	3.30	3.29	3.29	3.65	.99	7.93	7.00	6.94	6.00	10.06	10.00
1.59	.46	.63	.45	3.13	3.29	3.06	3.39	1.71	8.16	7.00	6.45	6.00	10.50	10.00
1.69	.13	.43	.35	2.60	2.47	7.84	2.54	1.79	12.17	11.00	10.38	10.00	8.43*	8.00
2.92	.48	1.61	.69	5.70	5.76	2.81	2.14	1.05	6.00	5.00	4.95	4.00	10.41*	10.00
4.38	—	.13	.11	4.62	4.94	2.61	1.98	.41	5.00	5.00	4.59	4.00	6.65	6.00
3.92	.15	.40	.16	4.63	4.94	1.62	2.67	.71	5.00	5.00	4.29	4.00	6.67	6.00
3.72	—	.04	.04	3.80	4.11	2.84	2.52	.56	5.92	6.00	5.36	5.00	5.31	5.00
1.09	.42	.43	.35	2.29	2.47	7.05	2.77	1.66	11.48	10.00	9.82	9.00	2.27	2.00
—	.50	.53	1.27	2.30	2.25	—	—	—	1.48	1.50	—	—	1.71**	1.50
3.23	.52	.61	.66	5.02	4.95	.96	3.84	1.22	6.02	6.00	4.80	4.00	8.68*	8.00
1.26	.19	.76	.47	2.68	2.47	4.02	4.61	1.17	9.80	9.00	8.63	8.00	6.63	6.00
1.79	.33	1.09	.55	3.76	4.00	4.63	4.45	1.61	10.69	8.00	9.08	6.00	7.07	5.00
2.10	.21	.57	.49	3.37	3.30	5.46	3.09	.89	9.44	10.00	8.55	8.00	6.09	6.00

* Nos. 313–421–507 Chlorine 1.14% equivalent to 1.51% potash, 6.92% potash as sulfate.
" 1184 " .89% " " 1.18% " 9.23% " " "
** No. 868 Potash figured at 5c per pound.
* " 820 Chlorine 1.00% equivalent to 1.32% potash, 7.36% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
The E. D. Chittenden Co. (Concluded)				
Chittenden's Fish and Potash Special Formula	Leominster		916	
" " " " " "	Charlton		972	
" " " " " "	Southbridge	$20.60	1012	8.88
" " " " " "	Mittineague		1135	
Chittenden's Complete Tobacco and Onion Grower	Sunderland	27.09	244	7.74
" " " " " "	Sunderland		246	
Chittenden's Complete Tobacco and Onion Grower	N. Amherst		408	
" " " " " "	Montague	26.67	634	8.00
" " " " " "	Southbridge		1146	
Chittenden's Tobacco Special	Sunderland	27.95	243	6.59
" " "	Montague		635	
Chittenden's Tobacco Special	N. Amherst	26.83	1063	8.80
Clay & Sons, Stratford, London, Eng.				
Clay's Fertilizer	Boston		510	
" "	Boston	21.24	574	10.27
	Boston		573	
Coe-Mortimer Co., 51 Chambers St., New York City.				
E. Frank Coe's Blood, Bone and Potash	N. Brookfield	29.21	1156	8.40
E. Frank Coe's Celebrated Special Potato	Westfield	17.48	1004	8.47
E. Frank Coe's Columbian Corn and Potato	Westfield	14.69	1040	8.84
E. Frank Coe's Complete Manure with 10% Potash	Easthampton	25.50	222	6.66
E. Frank Coe's Double Strength Potato Manure	Bridgewater	27.88	1227	7.46
E. Frank Coe's Double Strength Top Dressing	Sterling	42.28	1225	6.80
E. Frank Coe's Excelsior Potato Fertilizer	Mendon	23.80	1222	8.44
E. Frank Coe's Gold Brand Excelsior Guano	S. Williamstown	23.83	1202	9.22
E. Frank Coe's H. G. Ammoniated Superphosphate	N. Hanover		526	
" " " " " "	Westfield	17.31	1005	10.14
" " " " " "	Lee		1068	
E. Frank Coe's New Englander Corn and Pot. Fert.	N. Hanover		525	
" " " " " " " "	Sheffield	14.17	1191	9.10
" " " " " " " "	S. Williamstown		1194	
Peruvian Grass Top Dressing	S. Framingham	39.85	1224	7.74
Peruvian Tobacco Fertilizer	Easthampton	34.19	223	7.96
Peruvian Vegetable Grower	Gilbertville	29.59	1215	10.10
" " "	S. Framingham		1230	
E. Frank Coe's Red Brand Excelsior Guano	Concord	25.40	430	10.53
E. Frank Coe's Special Grass Top Dressing	Easthampton	23.69	225	6.57
E. Frank Coe's Standard Potato Fertilizer	Warren	26.55	1234	9.64
Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.				
IMP Plant Food	Boston	102.54	532	.40
Essex Fertilizer Co., 39 N. Market St., Boston, Mass.				
Essex A 1 Superphosphate	Gardner	13.26	1082	6.15
Essex Complete Man. for Corn, Grain and Grass	S. Lowell		753	
" " " " " " " "	Leominster	27.38	885	6.39
" " " " " " " "	Pratts Junct.		946	
Essex Complete Manure for Potatoes and Vegetables	Taunton		298	
" " " " " " "	S. Lowell		782	
" " " " " " "	Leominster	26.89	837	5.81
" " " " " " "	Pratts Junct.		1054	

* Nos. 1224 Chlorine .71% equivalent to .95% potash, 4.81% potash as sulfate.
" 223 " .71% " " .95% " 10.09% " " "
" 1215-1230 " 1.13% " " 1.50% " 7.42% " " "
" 225 " .34% " " .44% " 2.40% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.20	.14	.64	58	2.56	2.47	3.80	4.26	1.28	9.34	7.00	8.06	6.00	4.30	4.00
2.02	.37	.74	.65	3.78	3.30	4.34	3.82	1.99	10.15	10.00	8.16	8.00	5.25*	5.00
1.77	.48	.70	.59	3.54	3.30	4.25	4.57	2.02	10.84	10.06	8.82	8.00	5.02*	5.00
2.31	.39	.79	.93	4.42	4.30	2.08	2.26	1.20	5.54	4.00	4.34	3.00	7.28*	5.50
.23	.25	1.97	1.49	3.94	4.30	2.97	2.72	.10	5.79	4.00	5.69	3.00	6.98*	5.50
2.22	.08	1.28	.88	4.46	4.00	.06	2.39	5.89	8.34	7.00	2.45	1.12	.19**	.08
2.46	.23	1.04	.47	4.20	4.11	6.06	1.72	.82	8.60	8.00	7.78	7.00	7.46	7.00
.85	.34	.28	.20	1.67	1.65	5.27	2.90	.99	9.16	9.00	8.17	8.00	4.42	4.00
.64	.24	.19	.17	1.24	1.23	5.71	2.81	.87	9.39	9.50	8.52	8.50	2.71	2.50
1.11	.43	.63	.34	2.51	2.47	2.78	5.22	1.48	7.48	7.00	8.00	6.00	10.35	10.00
1.20	.39	1.32	.48	3.39	3.70	4.08	3.96	1.68	9.72	8.00	8.04	7.00	8.95	10.00
5.49	.70	1.19	.38	7.76	8.23	2.71	4.64	1.20	8.55	8.00	7.35	7.00	7.89	8.00
1.75	.12	.42	.29	2.58	2.47	5.01	2.34	1.12	8.47	8.00	7.35	7.00	8.64	8.00
1.44	.29	.61	36	2.70	2.47	6.35	2.38	1.35	10.08	9.00	8.73	8.00	6.53	6.00
.74	.38	.41	.29	1.82	1.85	4.59	3.63	1.30	9.52	9.00	8.22	8.00	3.43	3.00
.20	.22	.23	.28	.93	.82	5.06	3.34	1.58	9.98	9.00	8.40	8.00	3.31	3.00
5.28	.92	1.26	.50	7.96	8.23	1.25	3.29	1.28	5.82	6.00	4.54	4.50	5.76*	6.00
3.06	.33	.84	.31	4.54	4.94	3.00	3.53	.79	7.32	7.00	6.53	6.00	11.04*	10.00
2.14	.71	.31	.21	3.37	3.29	5.87	2.73	1.17	9.77	9.00	8.60	8.00	8.92*	9.00
2.13	.30	.36	.24	3.03	3.29	5.23	2.93	1.20	9.36	9.00	8.16	8.00	7.73	7.00
3.53	.13	.66	.23	4.55	4.94	1.94	2.43	.43	4.80	5.00	4.37	4.00	2.84*	3.00
2.01	.56	.41	29	3.27	3.29	3.10	2.87	2.07	8.04	7.00	5.97	6.00	9.88	10.00
13.87	—	—	—	13.87	13.50	28.32	.13	none	28.45	25.30	28.45	24.80	24.42†	24.60
.13	.65	.31	.27	1.36	1.25	4.12	2.70	.99	7.81	8.00	6.82	7.00	2.17	2.00
.21	1.30	1.02	.63	3.16	3.28	3.89	2.62	1.12	7.63	7.00	6.51	6.00	10.99	10.00
.47	1.16	.80	.67	3.10	3.28	4.31	2.25	.92	7.48	7.00	6.56	6.00	10.72	10.00

* Nos. 244-246 Chlorine 1.34% equivalent to 1.78% potash, 3.47% potash as sulfate
" 408-634-1146 " .68% " " .89% " 4.13% " " "
" 243-635 " 1.58% " " 2.11% " 5.17% " " "
" 1063 " 1.28% " " 1.69% " 5.29% " " "

† Potash as nitrate, valued at 5¼ cents.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Essex Fertilizer Co. (Concluded)				
Essex Complete Man. for Potatoes, Roots and Veg.	Spencer	$28.15	1086	6.93
Essex Grain, Grass and Potato Fertilizer	Taunton	17.14	270	7.11
Essex Grass and Top Dressing for Lawns and Meads.	Pratts Junct.	28.57	1053	6.11
" " " " " " " " "	Monson		1111	
Essex Lawn Dressing	Taunton	25.03	273	2.44
" " "	S. Lowell		746	
Essex Market Garden and Potato Manure	Billerica		666	
" " " " " "	Southwick	21.35	1035	7.03
" " " " " "	Spencer		1075	
Essex Peerless Potato Manure	Monson	28.27	1112	6.08
Essex Special Potato Phosphate	S. Acton	22.93	940	7.81
Essex Tobacco Starter and Grower	S. Lowell	26.69	740	
" " " " "	Southwick		1037	3.68
Essex XXX Fish and Potash	Taunton		265	
" " " " "	S. Acton	19.75	941	6.62
" " " " "	Pratts Junct.		945	
Essex XXX Fish and Potash	Spencer	18.36	1085	7.92
R. & J. Farquhar & Co., Boston, Mass.				
Pulverized Sheep Manure	Manf. Sample	8.11	1299	27.83
C. W. Hastings, Dorchester, Mass.				
Ferti-Flora, the Liquid Fertilizer	Boston	17.33	1060	83.02
International Agric. Corp., Buffalo, N. Y. Buffalo Fertilizer Works. Branch,				
Celery and Potato Special	W. Bridgewater		909	
" " " "	Springfield	23.08	966	9.27
" " " "	Pepperell		1023	
Farmer's Choice	Medway		467	
" "	Springfield	16.71	852	10.63
" "	W. Brookfield		1150	
Fish Guano	Springfield	14.01	849	12.09
High Grade Manure	N. Amherst		100	
" " "	Hadley	28.91	393	11.98
" " "	Easthampton		414	
High Grade Manure	N. Hadley		685	
" " "	Springfield	27.29	854	12.04
" " "	W. Bridgewater		902	
New England Special	Medway		466	
" " "	Springfield		850	
" " "	Brookfield	20.34	1142	10.14
" " "	W. Brookfield		1152	
Onion Formula	Easthampton	27.29	409	12.15
Tobacco Producer	Hadley	30.41	394	12.08
" "	Easthampton		413	
Top Dressing	Hadley		395	
" "	Springfield	30.54	853	11.92
" "	Pepperell		1018	
Vegetable and Potato	Springfield	22.08	851	8.29
Johnson Seed Potato Co., Leominster, Mass.				
Ideal Potato Manure, Hoeing Brand	Bernardston	27.51	1210	11.04
Ideal Potato Manure, Planting Brand	Bernardston	29.45	1213	8.19

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.23	1.47	.95	.68	3.33	3.28	3.93	2.78	.87	7.58	7.00	6.71	6.00	11.07	10.00
.86	.50	.19	.15	1.70	.82	5.33	2.96	.74	9.03	9.00	8.29	8.00	3.88	4.00
1.04	1.26	1.04	.52	3.86	4.10	5.04	2.61	1.56	9.21	8.00	7.65	7.00	7.94	8.00
3.29	.09	.07	.06	3.51	4.10	5.97	2.45	.08	8.50	8.00	8.42	7.00	5.48	6.00
.30	.89	.52	.49	2.20	2.00	5.49	2.98	1.15	9.62	9.00	8.47	8.00	6.16	5.00
1.04	1.08	.87	.87	3.86	4.10	4.53	2.99	1.05	8.57	8.00	7.62	7.00	8.01	8.00
.28	1.00	.86	.41	2.55	2.46	5.27	3.13	1.17	9.57	9.00	8.40	8.00	6.53	6.00
1.74	.96	.77	.58	4.05	4.10	1.28	3.85	2.04	7.17	5.00	5.13	4.00	6.28*	6.00
.19	.87	.66	.48	2.20	2.00	5.23	2.57	1.51	9.31	9.00	7.80	8.00	4.75	3.00
.41	.96	.48	.35	2.20	2.00	5.46	2.81	.71	8.98	9.00	8.27	8.00	3.06	3.00
—	.26	.37	.75	1.38	1.38	—	—	—	.89	.89	—	—	1.88†	1.88
2.94	—	—	—	2.94	3.25	—	—	—	3.25	3.67	3.25	3.67	3.35**	3.30
.72	.39	.46	.38	1.95	1.60	2.74	4.84	1.22	8.80	9.00	7.58	8.00	10.50	10.00
.25	.33	.30	.29	1.17	.80	2.91	5.10	1.61	9.62	9.00	8.01	8.00	5.81	5.00
.52	.12	.21	.25	1.10	.80	4.88	4.00	1.10	9.98	10.00	8.88	9.00	2.19	2.00
1.61	.84	.46	.40	3.31	3.30	6.42	1.31	1.17	8.90	8.00	7.73	7.00	10.81	10.00
1.87	.22	.57	.42	3.08	3.30	4.12	3.20	1.25	8.57	8.00	7.32	7.00	10.59	10.00
.65	.52	.44	.35	1.96	1.60	2.72	6.08	1.51	10.31	10.00	8.80	9.00	5.93	5.00
1.37	.15	.96	.37	2.85	2.47	7.31	3.53	.54	11.38	11.00	10.84	10.00	8.21	8.00
1.81	.74	1.18	.89	4.62	4.50	4.46	2.68	1.89	9.03	6.00	7.14	5.00	5.95	5.50
3.47	.91	.55	.40	5.33	5.70	.89	5.26	1.84	7.99	7.00	6.15	6.00	5.74	5.00
.55	1.23	.34	.36	2.48	2.40	.16	7.62	2.04	9.82	9.00	7.78	8.00	6.63	7.00
2.47	.22	.26	.24	3.19	3.29	6.95	1.62	.26	8.83	—	8.57	8.00	8.69*	10.00
2.27	.19	.44	.33	3.23	3.28	7.65	1.64	.20	9.49	8.00	9.29	8.00	10.09*	10.00

* Nos. 740–1037 Chlorine .64% equivalent to .85% potash, 5.43% potash as sulfate.
" 394–413 " .48% " " .64% " 5.31% " " "
" 1210 " 4.30% " " 5.71% " 2.98% " " "
" 1213 " 5.51% " " 7.35% " 2.74% " " "

† Potash figured at 5c per pound.

** Potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Listers Agric. Chem. Works, Newark, N. J.				
Lister's Celebrated Onion Fertilizer	Hatfield	$26.73	669	10.70
Lister's Complete Tobacco Manure	Bradstreet	24.31	121	8.54
" " " "	Hadley		355	
Lister's High Grade Special for Spring Crops	Sunderland		58	
" " " " " " "	N. Amherst	23.66	738	11.10
" " " " " " "	Billerica		760	
Lister's Potato Manure	Pepperell	25.97	1022	9.93
Lister's Special Corn Fertilizer	Sunderland		54	
" " " "	Fall River	15.84	401	11.88
" " " "	S. Deerfield		472	
Lister's Special Corn Fertilizer	Billerica	14.76	659	9.38
Lister's Special Potato Fertilizer	Hadley		352	
" " " "	Fall River	17.69	381	14.12
" " " "	S. Deerfield		474	
Lister's Special Potato Fertilizer	Marblehead	18.18	595	
" " " "	Pepperell		1021	11.92
Lister's Special Tobacco Fertilizer	Hadley	20.62	354	10.20
" " " "	Belchertown		1032	
Lister's Standard Grass Fertilizer	Hadley	20.47	1220	12.13
Lister's Success Fertilizer	Hadley	15.99	351	11.20
" " "	Billerica		656	
Lister's 10% Potato Grower	Millis	27.38	420	11.78
" " " "	S. Deerfield		473	
Lowell Fertilizer Co., Boston, Mass.				
Lowell Animal Brand for all Crops	Raynham	21.22	276	8.55
" " " " " "	Sunderland		284	
Lowell Animal Brand for all Crops	Whitman		448	
" " " " " "	Sunderland	20.51	491	8.13
" " " " " "	Woburn		762	
Lowell Bone Fert. for Corn, Grain, Grass and Veg.	Woburn		662	
" " " " " " " " "	Sunderland		678	
" " " " " " " " "	S. Lowell		741	
" " " " " " " " "	Hudson	16.52	1080	6.61
" " " " " " " " "	Spencer		1089	
" " " " " " " " "	Springfield		1109	
" " " " " " " " "	E. Wilbraham		1133	
Lowell Corn and Vegetable	N. Amherst	26.83	416	8.89
Lowell Empress Brand for Corn, Potatoes and Grain	S. Lowell		749	
" " " " " " " "	Southbridge		1013	
" " " " " " " "	Southwick	14.04	1058	5.77
" " " " " " " "	Spencer		1088	
Lowell Special Grass Mix. for Top Dress. and Lawn	S. Lowell		747	
" " " " " " " " "	Leominster	27.18	886	4.42
" " " " " " " " "	Fitchburg		911	
Lowell Market Garden Manure	S. Lowell	27.17	757	8.49

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
2.26	.34	.47	.40	3.47	3.29	5.39	2.61	1 53	9.53	9.00	8.00	8.00	7.32	7.00
1.75	.30	1 08	72	3.85	4.11	2.90	1.79	1.20	5.89	5.00	4.69	4.00	5.41*	5.00
.61	.39	.43	.36	1.79	1.65	7.82	.73	.94	9.49	9.00	8 55	8.00	10.50	10.00
1.88	.42	.67	.33	3.30	3.29	4.15	3.89	1.20	9.24	9.00	8.04	8.00	7.40	7.00
.38	.36	.33	.28	1.35	1.23	6.25	2.40	1.30	9.95	9.00	8 65	8.00	3.14	3.00
.53	.33	.22	.18	1 26	1.23	4.66	3.25	.94	8.85	9.00	7.91	8.00	3.36	3.00
.42	.63	.35	.37	1.77	1.65	5.84	2.89	1.45	10.18	9.00	8.73	8.00	3.37	3.00
1.16	.18	.30	.29	1.93	1.63	4.95	3 41	1.28	9.64	9.00	8.36	8.00	3.85	3.00
.30	.82	.81	.44	2.37	2.06	5.36	3.29	2.27	10.92	9.00	8.65	8.00	3.40*	3.00
1.14	.49	.49	.41	2.53	2 47	4.44	5.20	1.94	11.58	10.00	9.64	9.00	2.39	2.00
.55	.39	.32	.23	1.49	1.23	6.09	2 87	1.35	10.30	10.00	8.96	9.00	2.43	2.00
1.75	.52	.49	.47	3.23	3.29	4.27	2.26	1.61	8.14	7.00	6.53	6.00	10.58	10.00
.19	1.11	.67	.52	2.49	2.46	4.75	4.47	.71	9.93	9.00	9.22	8.00	4.28	4.00
.32	.93	.75	.44	2.44	2.46	5.33	2.65	1.43	9.41	9.00	7.98	8.00	4.45	4.00
.14	.71	.51	34	1.70	1.64	6.83	1.18	1.15	9.16	9.00	8.01	8 00	2.97	3.00
23	1.37	.91	.77	3.28	3.28	6.12	1 89	1 45	9.46	9.00	8.01	8.00	7 99	7.00
.13	.64	.32	.30	1.39	1.24	5.46	2.04	1.07	8.57	8.00	7.50	7.00	2.12	2.00
2.60	.48	.69	.33	4.10	4.10	5.36	2.06	.64	8.06	8.00	7.42	7.00	6.03	6.00
.24	1.28	1.56	.95	4.03	4.10	4.27	2.95	1.20	8.42	8.00	7.22	7.00	6.12	6.00

* Nos. 121– 355 Chlorine 1.31% equivalent to 1.75% potash, 3.66% potash as sulfate.
" 354–1032 " 1.09% " " 1.44% " 1.96% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Lowell Fertilizer Co., (Concluded)				
Lowell Potato Manure	Whitman		449	
" " "	Norwood		876	
" " "	Southbridge	$16.47	1029	7.03
" " "	Springfield		1108	
" " "	E. Wilbraham		1132	
Lowell Potato Grower with 10% Potash	S. Lowell	27.57	754	5.59
Lowell Potato Phosphate	Hatfield	23.29	220	7.69
" " "	Raynham		277	
Lowell Potato Phosphate	Lowell		605	
" " "	Woburn	22.21	761	7.13
" " "	Hudson		1079	
Lowell Special Grass Mixture	S. Lowell	27.37	742	8.85
" " " "	Norwood		882	
Lowell Special Potato Fertilizer with 10 % Potash	Raynham	23.40	302	6.39
" " " " " " "	E. Wilbraham		1131	
Lowell Sterling Phosphate	S. Lowell	14.11	755	8.06
" " "	Southbridge		1025	
Lowell Superior with 10% Potash	Raynham	29.67	266	7.89
" " " " "	Seekonk		365	
Lowell Superior with 10% Potash	Concord	28.66	665	6.90
James E. McGovern, Andover, Mass.				
Andover Animal Fertilizer	Lawrence	24.59	559	10.15
Manufacturer's Wool Stock Co., Millbury, Mass.				
Merino Brand Sheep Manure	Millbury	9.38	1094	3.41
Merino Brand Sheep Manure	Millbury	8.22	1245	4.99
Mapes' Formula and Peruvian Guano Co., N. Y. City.				
Mapes' Average Soil Complete Manure	Boston		516	
" " " " "	Fitchburg	28.30	806	7.89
" " " " "	Southwick		1038	
Mapes' Cauliflower and Cabbage Manure	Boston		504	
" " " " "	Fitchburg	27.48	822	7.47
" " " " "	Worcester		881	
Mapes' Cereal Brand	Southwick	15.71	1036	7.57
Mapes' Complete Manure for General Use	Taunton	25.12	271	10.40
" " " " "	Boston		482	
Mapes' Complete Manure with 10% Potash	Enfield	21.51	1030	5.69
Mapes' Corn Manure	Taunton		229	
" " "	Boston	22.73	515	11.13
" " "	Northampton		538	
Mapes' Corn Manure	Springfield	22.92	964	9.68
Mapes' Economical Potato Manure	Boston		512	
" " " "	Fitchburg	28.12	803	7.14
" " " "	Worcester		878	
Mapes' Fruit and Vine Manure	Boston	24.30	513	5.40
" " " " "	Worcester		837	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.19	.90	.34	.30	1.73	1.64	4.59	2.45	.84	7.88	8.00	7.04	7.00	4.11	4.00
.27	1.43	.91	.73	3.34	3.28	3.76	3.00	1.07	7.83	7.00	6.76	6.00	10.22	10.00
.23	1.19	.65	.46	2.53	2.46	5.45	3.93	.82	10.20	9.00	9.38	8.00	6.26	6.00
.22	1.19	.61	.44	2.46	2.46	5.27	3.17	1.25	9.69	9.00	8.44	8.00	6.01	6.00
.26	1.57	1.32	.85	4.00	4.10	4.59	2.63	1.40	8.62	8.00	7.22	7.00	6.36	6.00
.21	1.10	.70	.45	2.46	2.46	4.27	1.83	1.22	7.32	7.00	6.10	6.00	9.74	10.00
.04	.46	.20	.15	.85	.82	5.59	2.77	.82	9.18	9.00	8.36	8.00	3.88	4.00
.66	1.19	1.06	.64	3.55	3.69	3.38	4.86	.56	8.80	8.00	8.24	7.00	10.70	10.00
.42	.88	1.36	.79	3.45	3.69	4.66	2.87	1.30	8.83	8.00	7.53	7.00	10.11	10.00
.36	.97	1.31	1.13	3.77	3.00	.51	6.43	3.11	10.05	6.00	6.94	5.00	4.07	3.00
—	.61	.35	.47	1.43	1.35	—	—	—	.31	.48	—	—	3.41‡	3.51
—	.51	.30	.46	1.27	1.35	—	—	—	.31	.48	—	—	2.89‡	3.51
2.77	.19	.59	.58	4.13	4.12	1.31	6.47	.66	8.44	8.00	7.78	7.00	5.96†	5.00
2.89	.31	.56	.54	4.30	4.12	1.34	5.52	.54	7.40	6.00	6.86	6.00	6.57	6.00
.76	.22	.45	.44	1.87	1.65	.57	5.63	2.32	8.52	8.00	6.20	6.00	3.22	3.00
2.38	.40	.46	.39	3.63	3.29	1.06	7.11	2.19	10.36	10.00	8.17	8.00	4.69*	4.00
1.25	.16	.48	.40	2.29	2.06	.29	3.41	1.94	5.64	5.00	3.70	3.00	10.78	10.00
1.59	.21	.45	.37	2.62	2.47	1.08	6.06	3.93	11.07	10.00	7.14	8.00	6.53	6.00
1.39	.27	.41	.43	2.50	2.47	.68	8.15	1.94	10.77	10.00	8.83	8.00	6.65	6.00
2.41	.56	.36	.28	3.61	3.29	.38	4.75	1.43	6.56	6.00	5.13	4.00	9.58*	8.00
1.15	—	.46	.46	2.07	1.65	.57	5.63	1.45	7.65	7.00	6.20	5.00	10.51*	10.00

† Potash as sulfate.
* Nos. 271–482 Chlorine 3.34% equivalent to 4.42% potash, .27% potash as sulfate.
" 512–803–878 " .51% " " .67% " 8.91% " " "
" 513–837 " .31% " " .41% " 10.10% " " "
‡ Potash figured at 5c per pound.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Mapes' Formula and Peruvian Guano Co. (Concluded)				
Mapes' Grass and Grain Spring Top Dressing	Taunton	$29.38	275	8.89
" " " " " " "	Boston		511	
" " " " " " "	Fitchburg		804	
" " " " " " "	Worcester		813	
Mapes' Lawn Top Dressing	Taunton	15.43	269	6.63
Mapes' Potato Manure	Taunton	29.25	268	10.31
" " "	Boston		509	
" " "	Northampton		537	
Mapes' Potato Manure	Fitchburg	28.28	802	8.87
" " "	Worcester		838	
" " "	Springfield		963	
Mapes' Tobacco Ash Constituents	Westfield	27.99	1001	.96
Mapes' Tobacco Manure, Wrapper Brand	Westfield	43.30	1000	11.56
" " " " "	Conway		1183	
Mapes' Tobacco Starter, Improved	Westfield	25.24	1002	9.52
" " " "	Southwick		1044	
Mapes' Top Dresser Improved Full Strength	Boston	44.01	520	7.97
Mapes' Top Dresser Improved Half Strength	Southwick	22.78	1034	8.63
Mapes' Vegetable Manure for Light Soils	Boston	32.55	475	8.02
" " " " " "	Northampton		536	
" " " " " "	Springfield		965	
National Fertilizer Co., 92 State St., Boston, Mass.				
Chittenden's Ammoniated Bone Phosphate	Saundersville	15.89	893	10.74
" " " "	Leominster		913	
Chittenden's Complete Grass Fertilizer	Bradstreet	25.65	72	9.21
Chittenden's Complete Root and Grain Fertilizer	Sunderland	25.34	182	10.55
" " " " " "	Sunderland		188	
" " " " " "	Sunderland		197	
" " " " " "	Sunderland		204	
" " " " " "	Sunderland		209	
Chittenden's Complete Root and Grain Fertilizer	Dighton	25.51	307	10.54
" " " " " "	Leominster		912	
" " " " " "	S. Framingham		987	
Chittenden's Complete Tobacco Fertilizer	N. Hadley	25.79	141	7.50
" " " "	Sunderland		245	
" " " "	Sunderland		280	
" " " "	Sunderland		285	
" " " "	Sunderland		343	
Chittenden's Conn. Valley Tobacco Grower	Feeding Hills	35.63	1105	9.56
Chittenden's Conn. Valley Tobacco Grower	Feeding Hills	36.32	1268	10.72
Chittenden's Conn. Valley Tobacco Starter	Feeding Hills	33.31	1106	8.14
Chittenden's Eureka Potato Fertilizer	Dighton	23.19	306	8.59
" " " "	Saundersville		896	
Chittenden's Fish and Potash	Sunderland	21.72	342	10.95
" " " "	Sunderland		348	
" " " "	N. Westport		374	
" " " "	Sunderland		541	

*Nos. 141-245-280-285-343 Chlorine .94%, equivalent to 1.25% potash, 4.16% potash as sulfate.
No. 1105 Trace of chlorine, 1.78% potash as sulfate, 7.13% potash as carbonate, 9.34% total potash.
" 1268 Trace of chlorine, 1.07% potash as sulfate, 8.35% potash as carbonate.
" 1106 Chlorine .15%, equivalent to .20% potash, 2.97% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
3.15	.56	.61	.52	4.84	4.94	.68	4.88	1.02	6.58	6.00	5.56	5.00	7.52	7.00
2.41	.20	.05	.04	2.70	2.47	.51	1.94	1.02	3.47	3.50	2.45	2.00	3.52	2.50
1.86	1.04	.53	.41	3.84	3.71	2.49	6.39	1.12	10.00	8.00	8.88	8.00	6.88*	6.00
2.66	.31	.59	.38	3.94	3.71	2.42	5.69	.97	9.08	8.00	8.11	8.00	6.58*	6.00
.06	.24	.17	.16	.63	.50	.10	1.86	3.93	5.89	5.70	1.96	—	15.05*	15.00
3.71	.59	1.39	.89	6.58	6.18	.06	3.84	1.43	5.33	4.50	3.90	—	10.54*	10.00
1.88	.19	1.26	.99	4.32	4.12	.48	8.29	.69	9.46	8.00	8.77	6.00	1.72*	1.00
8.00	.54	.24	.17	8.95	9.88	.23	8.01	.97	9.21	8.00	8.24	5.00	3.75*	4.00
3.81	.60	.13	.13	4.67	4.94	.23	2.96	1.40	4.59	4.00	3.19	2.50	2.19*	2.00
3.17	.44	.93	.71	5.25	4.94	.38	6.49	1.86	8.73	8.00	6.87	6.00	6.46*	6.00
.75	.26	.35	.24	1.60	1.65	5.10	3.22	1.63	9.95	9.00	8.32	8.00	2.44	2.00
2.24	.27	.77	.56	3.84	4.11	4.12	2.39	1.73	8.24	7.00	6.51	6.00	5.86	5.00
1.94	.36	.60	.39	3.29	3.29	5.65	2.46	1.15	9.26	9.00	8.11	8.00	6.48	6.00
1.83	.51	.59	.37	3.30	3.29	4.72	3.29	2.17	10.18	9.00	8.01	8.00	6.35	6.00
2.49	.14	.47	.27	3.37	3.29	4.72	3.54	1.61	9.87	9.00	8.26	8.00	5.41*	5.00
.55	—	2.87	1.47	4.89	4.94	.80	3.69	.41	4.90	4.00	4.49	1.00	8.91*	8.00
.20	.65	2.61	1.34	4.80	4.94	.96	3.17	.54	4.67	4.00	4.13	1.00	9.42*	8.00
4.30	.72	1.16	.86	7.04	8.23	.51	3.83	.46	4.80	4.00	4.34	1.00	3.17*	2.50
1.54	.26	.38	.22	2.40	2.47	4.08	2.17	1.28	7.53	7.00	6.25	6.00	9.77	10.00
1.56	.21	.63	.60	3.00	2.88	4.27	2.54	1.71	8.52	7.00	6.81	6.00	4.61	4.00

* Nos. 268–509–537 Chlorine .66% equivalent to .88% potash, 6.00% potash as sulfate.
" 802–838–963 " 1.68% " " 2.24% " 4.34% " " "
" 1001 " .69% " " .92% " 1.69% " " "
12.44% potash as carbonate, 15.29% total potash.

* Nos. 1000–1183 Chlorine, 1.05% equivalent to 1.39% potash, 1.55% potash as sulfate, 7.60% potash as carbonate, 10.82% total potash.

* Nos. 1002–1044 Chlorine .49% equivalent to .67% potash, 1.05% potash as sulfate.
" 520 " .56% " " .73% " 3.02% " " "
" 1034 " .16% " " .21% " 1.98% " " "
" 475–536–965 " .49% " " .66% " 5.80% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
National Fertilizer Co., (Concluded)				
Chittenden's Fish and Potash	W. Springfield		767	
" " " "	Saundersvillle	$20.67	898	10.18
" " " "	S. Framingham		984	
Chittenden's H. G. Special Tobacco Fertilizer	N. Hadley	33.21	819	5.96
Chittenden's Market Garden Fertilizer	Sunderland		186	
" " " "	Sunderland	22.39	205	11.84
" " " "	N. Westport		367	
Chittenden's Market Garden Fertilizer	Saundersville	22.84	895	10.75
Chittenden's Potato Phosphate	Dighton	21.57	308	10.37
Chittenden's Tobacco Special with Carb. of Potash	N. Hadley		154	
" " " " " " "	N. Hadley		169	
" " " " " " "	Sunderland	27.94	171	9.47
" " " " " " "	Sunderland		185	
" " " " " " "	Sunderland		203	
Chittenden's Tobacco Special with Carb. of Potash	N. Hadley	28.75	646	8.44
Chittenden's Tobacco Special with Sul. of Potash	Northampton	28.09	724	6.91
Chittenden's XXX Fish and Potash	N. Amherst	17.40	303	9.03
" " " " "	N. Westport		368	
Natural Guano Co., Aurora, Ill.				
"Sheep's Head" Pulverized Manure	Lynn		612	
" " " "	Worcester	12.80	830	7.60
" " " "	S. Framingham		986	
New England Fertilizer Co., 40A N. Market St. Boston.				
New England Complete Manure	Salem	27.24	786	8.41
" " " "	Brockton		1162	
New England Corn Phosphate	Salem	17.17	778	5.86
" " " "	Brockton		1170	
New England H. G. Potato Fertilizer	Salem	22.33	764	10.17
" " " " "	Brockton		1161	
New England H. G. Special with 10% Potash	Barre Plains	28.72	1145	6.40
New England Perfect Tobacco Grower	Agawam	25.46	1126	2.89
New England Potato Fertilizer	Natick	16.54	608	6.44
" " " "	Brockton		1171	
New England Superphosphate for all Crops	Natick	20.29	545	7.19
" " " " " "	S. Lowell		781	
Olds and Whipple, Hartford, Ct.				
O. & W. Complete Corn and Potato Fertilizer	N. Hatfield	27.84	1208	5.69
O. & W. Complete Grass Fertilizer	N. Hadley	26.71	136	9.19
" " " "	Sunderland		485	
O. & W. Complete Onion Fertilizer	N. Hadley		138	
" " " "	Hadley	26.33	356	7.48
" " " "	Plainville		500	
O. & W. Complete Onion Fertilizer	N. Hadley	26.13	163	8.41
O. & W. Complete Tobacco Fertilizer	N. Hadley		107	
" " " "	N. Hadley		120	
" " " "	Bradstreet	30.09	124	8.10
" " " "	N. Hadley		159	
" " " "	Southwick		201	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.60	.31	.71	.38	3.00	2.88	3.38	3.08	1.81	8.27	7.00	6.46	6.00	3.78	4.00
3.36	.35	.88	.52	5.11	5.76	3.87	1.97	1.07	6.91	6.00	5.84	5.00	8.60*	10.00
.88	.36	.77	.46	2.47	2.47	5.36	2.81	1.81	9.98	9.00	8.17	8.00	6.24	6.00
1.14	.54	.46	.33	2.47	2.47	5.14	3.05	1.48	9.67	9.00	8.19	8.00	6.95	6.00
1.34	.30	.40	.28	2.32	2.06	5.49	2.92	1.28	9.69	9.00	8.41	8.00	6.00	6.00
.32	1.05	2.02	1.34	4.73	4.53	.26	3.82	—	4.08	4.00	4.08	3.00	5.51*	5.50
.37	.52	2.55	1.32	4.76	4.53	.55	3.17	.08	3.80	4.00	3.72	3.00	5.59*	5.50
.42	.02	2.45	1.76	4.65	4.53	.32	3.63	.03	3.98	4.00	3.95	3.00	6.96*	5.50
1.15	.26	.70	.44	2.55	2.47	2.97	2.29	1.45	6.71	6.00	5.26	5.00	3.23	3.00
—	.79	.50	1.12	2.41	2.25	—	—	—	1.66	1.25	—	—	1.83†	1.50
.24	1.19	1.16	.66	3.25	3.28	4.15	2.23	1.12	7.50	7.00	6.38	6.00	10.53	10.00
.14	.71	.59	.38	1.82	1.64	5.42	2.82	1.25	9.49	9.00	8.24	8.00	3.09	3.00
.74	.70	.75	.36	2.55	2.46	5.74	2.86	.46	9.06	9.00	8.60	8.00	5.97	6.00
.23	1.28	1.19	.74	3.44	3.69	4.31	3.40	1.22	8.93	8.00	7.71	7.00	10.09	19.00
1.48	1.01	.90	.43	3.82	4.10	1.12	3.73	1.94	6.79	5.00	4.85	4.00	6.24*	6.00
.20	.91	.32	.32	1.75	1.64	5.20	1.87	.74	7.81	8.00	7.07	7.00	4.03	4.00
.18	1.09	.66	.46	2.39	2.46	5.42	3.00	1.02	9.44	9.00	8.42	8.00	4.15	4.00
1.37	.03	1.47	1.07	3.94	3.30	2.59	5.11	1.51	9.21	6.00	7.70	6.00	7.03	6.00
2.38	.02	.65	.54	3.59	3.30	.23	6.61	2.04	8.88	7.00	6.84	6.00	6.93*	6.00
.95	.53	1.05	1.04	3.57	3.30	2.81	4.28	2.12	9.21	7.00	7.09	6.00	7.12	6.50
1.09	.25	1.20	1.00	3.54	3.30	2.87	4.20	2.27	9.34	7.00	7.07	6.00	6.98	6.50
.65	1.72	1.19	1.31	4.87	4.50	.19	3.47	.38	4.04	3.00	3.66	3.00	6.36*	5.50

* No. 819 Chlorine 1.45% equivalent to 1.92% potash, 6.68% potash as sulfate.
Nos. 154–169–171–185–203 Chlorine .81% equivalent to 1.06% potash, 2.38% potash as sulfate, 2.07% potash as carbonate, 6.47% total potash.
No. 646 Chlorine .64% equivalent to .84% potash, 1.23% potash as sulfate, 3. 52% potash as carbonate, 6.47% total potash.
" 724 Chlorine .15% " " .20% " 6.76% " " "
" 1126 " .87% " " 1.15% " 5.09% " " "
" 136–485 " 1.13% " " 1.50% " 5.43% " " "
" 107–120–124–159–201 " .30% " " .40% " 1.20% " " " 4.76% potash as carbonate, 6.59% total potash.

† Potash figured at 5c per pound.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Olds and Whipple, (Concluded)				
O. & W. Fish and Potash	N. Hadley	$19 98	135	6.33
O. & W. High Grade Potato Fertilizer	N. Hadley	31.97	134	9.52
O. & W. Special Onion Fertilizer	Sunderland	25.32	488	8.20
Pan American Fertilizer Co., 39 Pearl St., N. Y. City.				
Pan American Market Garden Standard	Sunderland	22.22	208	7.81
Parmenter and Polsey Fert. Co., 40 N. Market St. Boston				
P. & P. A .A. Brand	Auburn	30.42	1090	8.19
P. & P. Aroostook Special with 10% Potash	S. Lowell	30.10	752	6.14
" " " " " "	Brookfield		1149	
P. & P. Plymouth Rock Brand for all Crops	S. Lowell		751	
" " " " " " "	N. Attleboro		870	
" " " " " " "	Holden	20.99	1092	6.84
" " " " " " "	Brookfield		1153	
P. & P. Potato Fertilizer	N. Attleboro	18.16	867	4.87
" " "	Brookfield		1144	
P. & P. Potato Grower with 10% Potash	Brookfield	23.83	1141	6.27
P. & P. Sp. Potato Fertilizer for Potatoes and Roots	S. Lowell	26.85	756	8.94
" " " " " " " " "	N. Attleboro		869	
P. & P. Star Brand Superphosphate	S. Lowell	17.16	748	5.64
" " " " "	Holden		1093	
R. T. Prentiss, Granby, Mass.				
R. T. Prentiss Complete for Corn and Grain	Chicopee	25.73	770	5.70
" " " " " " "	Holyoke		776	
R. T. Prentiss Complete for Potatoes	Holyoke	28.25	775	7.00
R. T. Prentiss Complete Top Dressing	Chicopee	35.29	769	4.93
" " " " "	Holyoke		774	
The Pulverized Manure Co., Chicago, Ill.				
Wizard Brand Sheep Manure	Taunton		289	
" " " "	Fall River		334	
" " " "	Concord	13.03	397	7.01
" " " "	Fitchburg		824	
Wizard Brand Cattle Manure	Taunton	11.96	272	11.72
The Rogers Manufacturing Co., Rockfall, Ct.				
All Round Fertilizer	N. Westport	17.18	376	8.12
" " "	Worcester		874	
Complete Potato and Vegetable Fertilizer	N. Westport		370	
" " " " "	Whately		580	
" " " " "	Worcester	22.21	880	7.72
" " " " "	Norwood		906	
Fish and Potash	N. Westport		377	
" " "	Amherst	23.78	650	6.36
" " "	Worcester		812	
H. G. Corn and Onion Fertilizer	N. Westport		369	
" " " " "	Fitchburg	28.26	807	7.76
" " " " "	Southwick		1041	
H. G. Grass and Grain	Sunderland	33.74	633	6.24
" " " "	Deerfield		1189	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.38	.14	1.37	.89	2.78	2.50	2.36	4.12	1.51	7.99	6.00	6.48	5.00	4.03	3.00
1.12	.01	1.53	1.07	3.73	3.30	1.31	6.44	.92	8.67	6.00	7.75	6.00	10.92*	10.00
1.16	.06	.99	.68	2.89	2.45	1.82	6.77	1.51	10.10	—	8.59	8.00	6.62*	6.00
1.50	.05	.53	.41	2.49	2.46	4.53	3.79	1.02	9.34	9.00	8.32	8.00	6.34	6.00
.30	1.66	1.54	.80	4.30	4.10	4.21	3.52	1.73	9.46	8.00	7.73	7.00	8.01	8.00
.22	1.57	1.20	.74	3.73	3.69	4.66	3.04	1.15	8.85	8.00	7.70	7.00	10.43	10.00
.18	1.02	.80	.51	2.51	2.46	5.42	2.74	1.30	9.46	9.00	8.16	8.00	4.57	4.00
.16	.74	.56	.29	1.75	1.64	3.61	3.35	.59	7.55	7.00	6.96	6.00	6.30	6.00
.19	1.09	.80	.40	2.48	2.46	4.08	2.40	1.07	7.55	7.00	6.48	6.00	9.89	10.00
.21	1.27	1.11	.69	3.28	3.28	5.84	2.38	1.22	9.44	9.00	8.22	8.00	7.94	7.00
.19	.90	.38	.37	1.84	1.64	5.04	2.13	.64	7.81	8.00	7.17	7.00	4.34	4.00
2.21	.21	.30	.30	3.02	2.88	6.42	2.02	.54	8.98	9.00	8.44	8.00	8.06	8.00
2.40	.05	.38	.22	3.05	3.29	7.76	1.58	.51	9.85	9.00	9.34	8.00	9.95	10.00
4.19	.59	.68	.47	5.93	5.76	5.36	1.73	.41	7.50	7.00	7.09	6.00	8.02	8.00
—	.54	.56	1.23	2.33	1.80	—	—	—	1.79	1.00	—	—	2.28†	1.00
—	.42	.51	1.26	2.19	1.80	—	—	—	1.43	1.00	—	—	2.06†	1.00
.65	.31	.57	.34	1.87	1.65	6.06	2.59	1.68	10.33	10.00	8.65	8.00	3.02	2.00
.16	.80	.87	.60	2.43	2.25	4.57	3.70	1.58	9.85	10.00	8.27	8.00	6.22	5.00
.75	.81	1.33	.95	3.84	3.25	2.17	3.03	1.84	7.04	6.00	5.20	4.00	4.88	3.75
.96	.34	1.48	.90	3.68	3.60	2.42	4.83	2.60	9.85	8.00	7.25	6.00	8.58	7.00
.42	.15	1.94	.68	3.19	3.00	.06	8.54	8.57	17.17	16.00	8.60	—	13.35	12.00

* No. 134 Chlorine .98% equivalent to 1.30% potash, 9.62% potash as sulfate.
" 488 " .57% " " .76% " 5.86% " " "
† Potash figured at 5c per pound.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
The Rogers Manufacturing Co., (Concluded)				
H. G. for Oats and Top Dressing	Deerfield	$38.56	95	7.64
" " " " " "	Plainville		234	
" " " " " "	Hadley		392	
" " " " " "	Deerfield		471	
H. G. Soluble Tobacco Manure	N. Amherst	37.62	405	6.43
" " " "	Fitchburg		825	
H. G. Soluble Tobacco Manure	Palmer	36.34	1298	5.75
H. G. Tobacco and Potato Manure	Deerfield	31.48	96	6.14
" " " " "	Plainville		236	
" " " " "	Amherst		403	
" " " " "	Sunderland		631	
" " " " "	Amherst		648	
" " " " "	Fitchburg		811	
H. G. Tobacco and Potato Manure	Whately	31.37	1283	6.71
H. G. Tobacco Grower	Spencer	29.89	1233	6.59
New H. G. Tobacco Grower, Veg. and Carb. Formula	Deerfield	29.20	94	7.23
" " " " " " " "	N. Amherst		404	
" " " " " " " "	Sunderland		632	
The Rogers and Hubbard Co., Middletown, Ct.				
Hubbard's "Bone Base" All Soil All Crop Phosphate	Hadley	27.21	626	7.93
" " " " " " "	E. Milton		697	
Hubbard's "Bone Base" Complete Phosphate	E. Milton	18.18	698	7.86
" " " " "	Wrentham		904	
" " " " "	Enfield		1031	
" " " " "	Agawam		1124	
Hubbard's "Bone Base" Fert. for Seed. Down & Fruits	Hadley	30.73	624	5.41
" " " " " " " " " "	N. Hatfield		675	
" " " " " " " " " "	W. Peabody		777	
Hubbard's "Bone Base" New Market Garden Phos.	N. Westport	24.03	372	7.68
" " " " " " " "	Salem		594	
" " " " " " " "	W. Peabody		785	
Hubbard's "Bone Base" Oats and Top Dressing	N. Hadley	45.21	149	2.61
" " " " " " "	Hadley		359	
" " " " " " "	N. Westport		378	
" " " " " " "	Hadley		622	
" " " " " " "	N. Hatfield		673	
" " " " " " "	E. Milton		723	
" " " " " " "	W. Peabody		784	
Hubbard's "Bone Base" Oats and Top Dressing	Wrentham	44.93	862	4.56
" " " " " " "	Sterling		949	
Hubbard's "Bone Base" Oats and Top Dressing	Lowell	45.55	1266	1.54
Hubbard's "Bone Base" Potato Phosphate	N. Westport	21.38	373	9.27
" " " " "	N. Hatfield		676	
" " " " "	E. Milton		696	
Hubbard's "Bone Base" Soluble Corn and General Crops	N. Hatfield	24.95	674	4.77
" " " " " " " "	W. Peabody		780	
" " " " " " " "	Wrentham		860	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
3.02	.97	1.40	.83	6.22	6.30	.48	8.58	1.58	10.64	9.00	9.06	7.00	8.60	7.50
1.16	.93	1.84	1.10	5.03	5.00	.55	8.51	.89	9.95	7.00	9.06	5.00	10.63*	10.50
1.05	.13	2.74	1.02	4.94	5.00	.61	5.74	1.07	7.42	7.00	6.35	5.00	11.81*	10.5
1.02	.89	1.24	.60	3.75	3.50	.42	7.75	.94	9.11	9.00	8.17	7.00	10.15*	8.75
1.27	.45	1.43	.55	3.70	3.50	.80	8.43	1.51	10.74	9.00	9.23	7.00	9.03	8.75
1.12	1.34	1.60	.97	5.03	5.00	.70	3.82	.38	4.90	4.00	4.52	3.00	6.91*	5.50
.87	.47	2.16	1.73	5.23	5.00	.70	2.34	.94	3.98	4.00	3.04	3.00	6.31*	5.50
2.41	.17	.45	.24	3.27	3.30	5.52	3.40	1.51	10.43	9.00	8.92	8.00	7.90	7.00
.55	.22	.46	.33	1.56	1.50	4.53	3.76	1.25	9.54	8.00	8.29	7.00	5.54	5.00
.30	.07	1.17	.69	2.23	2.20	.57	8.45	8.60	17.62	16.00	9.02	6.50	13.62	12.00
.89	.18	.72	.39	2.18	2.00	3.67	2.99	1.38	8.04	7.00	6.66	6.00	11.29	10.00
7.38	.35	.51	.32	8.56	8.50	.10	5.39	3.11	8.60	8.00	5.49	4.50	9.15	8.00
7.04	.30	.75	.27	8.36	8.50	—	8.13	2.17	10.30	8.00	8.13	4.50	7.64	8.00
7.36	.14	.53	.27	8.30	8.50	—	6.97	3.21	10.18	8.00	6.97	4.50	9.28	8.00
1.11	.20	.44	.40	2.15	2.00	6.00	3.06	1.86	10.92	10.00	9.06	9.00	5.56	5.00
1.32	.41	.56	.34	2.63	2.50	2.02	5.81	1.61	9.44	8.00	7.83	6.00	9.39	8.00

* Nos. 405–825 Chlorine .82% equivalent to 1.08% potash, 9.55% potash as sulfate.
" 1298 " 1.11% " " 1.47% " 10.34% " " "
" 96–236–403–631–648–811 " 1.04% " " 1.37% " 8.78% " " "
" 1283 " .39% " " .52% " 8.51% " " "
" 1233 " .74% " " .99% " 5.92% " " "
" 94–404–632 " .37% " " .49% " 5.82% " " "
6.67% total potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
The Rogers and Hubbard Co., (Concluded)				
Hubbard's "Bone Base" Soluble Potato Manure......	N. Hadley.....		146	
" " " " " "	N. Westport...		375	
" " " " " "	Hadley........	$33 26	625	8 70
" " " " " "	W. Peabody...		783	
Hubbard's "Bone Base" Soluble Potato Manure.....	Wrentham.....	33 43	861	9.75
" " " " " "	Sterling.......		948	
Hubbard's "Bone Base" Soluble Tobacco Manure....	N. Westport.	38.42	371	10.19
Tobacco Special..................................	N. Hadley.....		114	
" "	Hadley........		391	
" "	Plainville.. ...	26.77	501	4.81
" "	N. Hatfield ...		672	
Tobacco Special..................................	Hadley........	26 48	1065	5.74
Ross Brothers Co., 88 Front St., Worcester, Mass.				
Corn, Grain and Grass Fertilizer.....................	Worcester.....	24.97	834	8.39
High Grade Potato and Vegetable Fertilizer.........	Worcester.....	27.10	801	7.87
Potato and Vegetable Fertilizer....................	Worcester.....	17 61	826	7.66
Worcester Lawn Dressing..........................	Worcester.....	22.69	835	7.43
" " "	Springfield.....		855	
F. S. Royster Guano Co., Baltimore, Md.				
Royster's Champion Crop Compound..................	N. Adams.....	17 81	1203	8.35
Royster's Gold Seal Potato Special Guano...........	N. Woburn....		872	
" " " " " "	Leominster....	23 10	918	6.14
" " " " " "	Brooks Station.		1078	
Royster's Harvest King Fertilizer..................	Orange........	16.67	1175	7.98
" " " "	N. Adams.....		1204	
Royster's High Grade Corn Fertilizer...............	N. Woburn....		873	
" " " " "	Leominster....	17 86	923	5.27
" " " " "	Brooks Station.		1084	
Royster's High Grade Tobacco Manure.............	Westfield......	32.93	1237	6.81
Royster's High Grade Top Dresser................	Leominster....		917	
" " " " "	Brooks Station.		1083	
" " " " "	Auburn.......	36.86	1091	7.17
" " " " "	Orange......		1181	
Royster's Practical Truck Guano...................	N. Woburn....	21.25	871	7.99
Royster's Royal Special Potato Guano..............	N. Woburn....	27.14	713	8 81
Royster's Special Celery and Onion Guano	N. Woburn....	30 86	712	7.95
Royster's Universal Truck Fertilizer................	Leominster....	26 82	922	9.23
J. W. Sanborn, Pittsfield, N. H.				
Prof. Sanborn's Chem. Fertilizer for Grass and Grain	Saxonville.....	29.91	983	4.70
" " " " " " " "	Royalston.....		1178	
Prof. Sanborn's Chem. Fertilizer for Hill and Drill....	Royalston.....	22 13	1190	9.97
Prof. Sanborn's Chem. Fertilizer for Potatoes & Corn	Saxonville.....	28 67	988	6.72
" " " " " " " "	Royalston.....		1179	
Sanderson Fertilizer & Chem. Co., New Haven ,Ct.				
Sanderson's Atlantic Coast Bone, Fish and Potash....	Sunderland....		60	
" " " " " " "	N. Amherst....		101	
" " " " " " "	"	16 17	180	6.89
" " " " " " "	N. Hatfield....		684	

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
2.41	.35	1.33	.82	4.91	5.00	1.15	7.58	3.72	12.45	10.00	8.73	7.00	6.24*	5.00
2.37	.46	1.43	.77	5.03	5.00	.99	8.58	3.24	12.81	10.00	9.57	7.00	5.47*	5.00
2.81	.40	1.41	.42	5.04	5.00	.99	8.15	2.14	11.28	10.00	9.14	7.00	11.02*	10.00
.23	.43	1.95	1.63	4.24	4.10	.10	3.88	1.81	5.79	5.50	3.98	3.00	6.61*	5.00
.30	.18	2.32	1.31	4.11	4.10	.38	4.75	.74	5.87	5.50	5.13	3.00	6.28*	5.00
1.11	.25	.91	.44	2.71	2.87	6.48	1.81	.92	9.21	8.50	8.29	8.00	8.39	8.00
1.20	.11	.99	.48	2.78	2.87	6.95	1.09	1.07	9.11	8.50	8.04	8.00	10.72	10.00
.48	.03	.66	.38	1.55	1.65	4.72	3.52	.43	8.67	8.50	8.24	8.00	5.31	5.00
.98	.16	.75	.62	2.51	2.00	4.53	2.99	.87	8.39	10.00	7.52	6.00	7.56	4.00
1.09	.14	.31	.26	1.80	1.65	4.57	3.54	1.30	9.41	8.50	8.11	8.00	4.26	4.00
.90	.05	.41	.29	1.65	1.65	3.93	4.29	1.07	9.29	8.50	8.22	8.00	11.20	10.00
.91	.18	.45	.39	1.93	1.65	3.25	4.81	1.33	9.39	8.50	8.06	8.00	2.48	2.00
.83	.17	.40	.33	1.73	1.65	1.98	5.19	.92	8.09	7.50	7.17	7.00	5.97	5.00
2.24	.43	1.17	.88	4.72	4.94	2.87	2.87	.59	6.33	5.50	5.74	5.50	9.92*	10.00
4.90	.62	.55	.31	6.38	6.58	4.82	1.64	.99	7.45	6.50	6.46	6.00	8.31	8.00
1.12	.31	.63	.40	2.46	2.47	2.08	4.99	1.48	8.55	8.50	7.07	8.00	6.55	6.00
2.18	.18	.77	.50	3.63	4.11	3.35	4.26	1.17	8.78	7.50	7.61	7.00	7.83	7.00
1.68	.27	.95	.42	3.32	3.29	4.06	4.10	1.53	9.69	8.50	8.16	8.00	12.79	12.00
2.02	.24	.70	.55	3.51	3.29	3.48	4.37	1.79	9.64	8.50	7.85	8.00	7.46	7.00
4.74	.08	.20	.13	5.15	4.75	2.97	2.51	1.89	7.37	6.00	5.48	4.50	6.32	5.75
1.49	.26	.39	.19	2.33	2.40	7.95	1.56	1.28	10.79	11.50	9.51	7.00	5.31	4.00
2.33	.11	.80	.32	3.56	3.30	6.06	2.11	1.68	9.85	9.50	8.17	7.00	8.43*	8.00
.12	.26	.92	.60	1.90	1.67	2.78	2.27	1.94	6.99	6.00	5.05	4.00	4.55	4.00

* Nos. 146-375-625-783	Chlorine	1.16%	equivalent to	1.54%	potash,	4.70%	potash as sulfate.
" 861-948	"	.92%	"	" 1.21%	"	4.26%	" " "
" 371	"	1.11%	"	" 1.46%	"	9.56%	" " "
" 114-391-501-672	"	.64%	"	" .84%	"	5.77%	" " "
" 1065	"	.57%	"	" .75%	"	5.53%	" " "
" 1237	"	1.18%	"	" 1.57%	"	8.35%	" " "
" 988-1179	"	4.81%	"	" 6.39%	"	2.04%	" " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Sanderson Fertilizer and Chem. Co. (Concluded).				
Sanderson's Complete Tobacco Grower	Sunderland		59	
" " " "	N. Amherst		102	
" " " "	Sunderland		173	
" " " "	"	$27 11	183	7.71
" " " "	Whately		581	
" " " "	"		583	
" " " "	N. Hatfield		683	
" " " "	Northampton		725	
Sanderson's Complete Tobacco Grower	Hadley	29.14	1064	8.26
Sanderson's Corn Superphosphate	Southwick		1043	
" " "	Three Rivers	18.05	1104	10.57
" " "	Gt. Barrington		1195	
Sanderson's Formula A	Sunderland		52	
" " "	"		172	
" " "	"	24.42	486	6.95
" " "	N. Hatfield		681	
Sanderson's Formula B	Whately	27.04	578	6.56
Sanderson's Formula B	Agawam	27.57	1107	8.67
Sanderson's Potato Manure	Gt. Barrington	18.12	1196	10.19
Sanderson's Special with 10% Potash	N. Amherst	25.47	178	8.43
" " " " "	"		179	
Sanderson's Top Dressing for Grass and Grain	Sunderland		56	
" " " " " " "	"	28.99	493	8.54
" " " " " " "	Whately		680	
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
"Swift-Sure" Super-phosphate for General Use	Hatfield		83	
" " " " " " "	Sunderland	26.58	86	8.63
" " " " " " "	N. Hatfield		677	
A. M. Smith & Co., 33 Com. St., Boston, Mass.				
Equity Brand Dried Ground Hen Manure	Manf. Sample	32.94	1216	9.50
Wm. Thomson & Sons., Ltd., Clovenfords, Scotland.				
Thomson's Vine Plant and Vegetable Manure	Boston	32.00	577	4.90
Thomson's Sp. Top. Dress. and Chrysanthemum Man.	Boston	30.46	477	6.60
20th Century Specialty Co., Boston, Mass.				
"Scientific" 12L No. 1	Boston	10.26	1223	2.92
"Scientific" 12L No. 2	Boston	17.08	1232	3.21
"Scientific" 12L No. 3	Boston	22.02	1226	4.33
Whitman and Pratt Rendering Co., Lowell, Mass.				
W. & P. all Crop	Hadley		350	
" " "	Billerica	23.55	606	10.82
" " "	Pepperell		939	
W. & P. Corn Success Fertilizer	N. Chelmsford	19.12	960	7.07
W. & P. Potash Special	Chelmsford	26.68	603	6.21
W. & P. Potato Manure	Billerica	22.18	600	8.12
" " "	N. Chelmsford		955	
W. & P. Vegetable Grower	Pepperell	27.96	938	9.49

* Nos. 577 Chlorine 4.37% equivalent to 5.80% potash, 1.72% potash as sulfate.
" 1223 " 1.88% " " 2.50% " .89% " " "
" 1232 " 2.67% " " 3.53% " 1.88% " " "
" 1226 " 2.42% " " 3.20% " 3.06% " " "

† Potash figured at 5c per pound.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.19	.46	2.16	1.85	4.66	4.50	1.12	2.58	.20	3.90	4.00	3.70	3.00	6.14*	5.50
.20	.75	2.13	1.60	4.68	4.50	1.08	3.06	.15	4.29	4.00	4.14	3.00	7.73*	5.50
.14	.43	.88	.68	2.13	1.67	6.31	2.31	.69	9.31	9.00	8.62	7.00	2.54	2.00
.82	1.03	.75	.61	3.21	3.33	4.53	2.66	1.33	8.5[illegible]	8.00	7.19	6.00	6.55	6.00
1.24	.23	1.04	.78	3.29	3.33	3.19	3.98	2.76	9.93	10.00	7.17	6.00	7.34*	6.00
1.36	.29	.90	.86	3.41	3.33	3.23	4.62	2.25	10.10	10.00	7.85	6.00	7.17*	6.00
.13	.18	.81	.64	1.76	1.67	4.34	1.89	.66	6.89	8.00	6.23	5.00	6.80	6.00
.82	.29	.77	.66	2.54	2.50	4.08	2.78	2.02	8.88	8.00	6.86	5.00	10.39*	10.00
2.08	.59	.95	.57	4.19	4.00	4.95	2.47	1.33	8.75	—	7.42	7.00	7.42	7.00
.83	.49	.94	.68	2.94	2.88	7.88	2.55	2.17	12.60	12.00	10.43	9.00	5.39*	4.50
9.00	1.82	3.53	1.90	7.25	7.00	—	—	—	2.95	2.00	—	—	1.18†	1.00
1.60	.39	1.36	.58	3.93	3.50	7.14	3.30	3.52	13.96	12.00	10.44	8.00	7.52*	7.00
2.59	.39	1.07	.55	4.60	4.25	6.93	3.66	3.16	13.75	12.00	10.59	6.50	3.31	3.00
1.23	.04	.02	.01	1.30	1.00	1.44	1.31	.08	2.83	2.00	2.75	2.00	3.39*	3.00
1.79	.55	.03	.02	2.39	2.00	2.08	1.57	.20	3.85	3.00	3.65	3.00	5.41*	4.00
2.90	.18	.05	.05	3.18	3.00	3.04	1.91	.08	5.03	4.00	4.95	4.00	6.26*	5.00
1.14	.17	.89	.68	2.88	2.46	3.64	5.91	2.47	12.02	11.00	9.55	9.00	4.38	4.00
.21	.52	.70	.62	2.05	1.64	3.25	4.83	2.12	10.20	10.00	8.08	9.00	4.36	3.00
1.17	.50	.63	.59	2.89	2.87	2.91	4.52	1.22	8.65	8.00	7.43	6.00	10.68	10.00
.71	.34	.84	.71	2.60	2.46	3.99	3.79	2.30	10.08	9.00	7.78	7.00	5.68	5.00
1.05	.74	1.13	.65	3.57	3.29	1.15	6.94	2.45	10.54	10.00	8.09	8.00	8.14	7.00

* Nos. 59-102-137-183-581-583-683-725 Chlorine .68% equivalent to .90% potash, 5.24% potash as sulfate.
" 1064 " .82% " " 1.07% " 6.66% " " "
" 578 " .77% " " 1.01% " 6.33% " " "
" 1107 " 1.09% " " 1.44% " 5.73% " " "
" 178-179 " 6.46% " " 8.56% " 1.83% " " "
" 83-86-677 " .67% " " .89% " 4.50% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
Wilcox Fertilizer Co., Mystic, Ct.				
Wilcox Complete Bone Superphosphate	Fall River	$20 67	293	14.91
" " " "	Marblehead		592	
" " " "	Salem		596	
Wilcox Corn Special	Amherst	23.28	62	8.84
" " "	Fall River		335	
Wilcox Fish and Potash	Amherst	19.11	46	16.57
" " " "	New Bedford		259	
" " " "	Fall River		286	
Wilcox 4-8-10 Fertilizer	Deerfield	30.18	93	9.94
" " " " "	Fall River		287	
Wilcox 4-8-10 Fertilizer	Sunderland	31.37	540	9.45
Wilcox Grass Fertilizer	Dighton	27.40	318	11.43
" " "	Fall River		336	
Wilcox High Grade Fish and Potash	Dighton	24.36	320	15.02
" " " " " "	Hadley		358	
Wilcox High Grade Tobacco Special	Amherst	27.25	51	7.95
" " " " "	N. Hadley		232	
" " " " "	Hadley		357	
Wilcox Potato Fertilizer	Amherst	20.69	63	11.49
" " "	Fall River		296	
Wilcox Potato, Onion and Vegetable Phosphate	Amherst	28.21	61	9.76
" " " " " "	Plainville		233	
" " " " " "	New Bedford		242	
Wilcox Potato, Onion and Vegetable Phosphate	Fall River	27.43	324	9.02
" " " " " "	Hadley		360	
" " " " " "	Marblehead		593	
Wilcox Special Superphosphate	Three Rivers	15.57	1103	11.71
A.H. Wood & Co., Framingham, Mass.				
Wood's B. B. Fertilizer	Framingham	23.33	1051	10.45
Wood's 777 Fertilizer	Framingham	39.47	1052*	6.71
Wood's S. P. Fertilizer	Framingham	34.54	981	5.98

* According to the manufacturer, the shortage in nitrogen and the overrun in potash on this brand is due to a mistake of the workman in substituting a 200 lb. bag of sulfate of potash for a like amount of sulfate of ammonia.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
.29	.23	.87	.92	2.31	2.05	7.17	2.22	.92	10.31	9.00	9.39	8.00	3.91	3.00
.96	.16	.90	.63	2.65	2.46	7.63	1.30	.46	9.39	9.00	8.93	8.00	6.14	5.00
.29	.36	1.12	.81	2.58	2.46	1.40	5.43	1.05	7.88	6.00	6.83	5.00	3.90	3.00
1.83	.30	.75	.40	3.28	3.30	7.25	1.70	1.15	10.10	9.00	8.95	8.00	11.15*	10.00
2.48	.15	.86	.43	3.92	3.30	7.05	1.42	.51	8.98	9.00	8.47	8.00	10.48*	10.00
1.93	.31	1.08	.85	4.17	4.12	6.38	1.02	.56	7.96	7.00	7.40	6.00	5.83	5.00
.22	.66	1.46	1.21	3.55	3.30	4.27	2.41	.97	7.65	7.00	6.68	6.00	5.58	5.00
1.26	.17	1.28	1.12	3.83	3.30	—	5.38	1.94	7.32	7.00	5.38	5.00	7.54*	7.00
.19	.74	.82	.75	2.50	2.05	2.87	3.27	2.30	8.44	7.00	6.14	6.00	5.62*	5.00
1.36	.52	.92	.66	3.46	3.30	6.98	2.36	.89	10.23	9.00	9.34	8.00	7.66*	7.00
1.26	.44	.97	.67	3.34	3.30	7.40	1.78	.59	9.77	9.00	9.18	8.00	7.61*	7.00
.17	.11	.65	.48	1.41	1.03	2.49	6.09	2.06	10.64	9.00	8.58	8.00	2.71	2.00
1.31	.29	.39	.38	2.37	2.50	7.05	3.66	.59	11.30	11.00	10.71	7.00	5.81	5.00
5.26	.17	.23	.17	5.83	7.00	5.49	1.20	.15	6.84	9.00	6.69	7.00	12.91*	7.00
2.77	.35	.33	.25	3.70	4.00	6.80	1.95	.23	8.98	8.00	8.75	6.00	12.52*	12.00

* Nos. 93–287	Chlorine	8.09%	equivalent	to	10.74%	potash,	.41%	potash	as	sulfate.
” 540	”	7.42%	”	”	9.85%	”	.63%	”	”	”
” 51–232–357	”	.67%	”	”	.87%	”	6.67%	”	”	”
” 63–296	”	3.09%	”	”	4.10%	”	1.52%	”	”	”
” 61–233–242	”	5.17%	”	”	6.87%	”	.79%	”	”	”
” 324–360–593	”	5.42%	”	”	7.18%	”	.43%	”	”	”
” 1052	”	6.31%	”	”	8.38%	”	4.53%	”	”	”
” 981	”	.59%	”	”	.79%	”	11.73%	”	”	”

Fertilizers Furnishing Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
PHOSPHATE AND POTASH				
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Tobacco Ash Elements	Northampton	$22.40	671	5.87
" " " "	Springfield		848	
" " " "	Hadley		1067	
Coe-Mortimer Co., New York City.				
E. Frank Coe's Famous Prize Brand Grass and Grain Fertilizer	Gilbertville	11.60	1214	9.28
Lister's Agric. Chem. Works, Newark, N. J.				
Lister's Grain and Grass Fertilizer	Fall River	11.41	400	9.72
" " " "	Williamstown		1205	
Olds and Whipple, Hartford, Ct.				
O. & W. Potash and Bone Phosphate	N. Hadley	36.62	1206	9.00
O. & W. Potash and Bone Phosphate	Bradstreet	35.38	1270	3.71
WOOD ASHES				
Joseph Breck and Sons, Boston, Mass.				
Breck's H. G. Wood Ashes	Manuf. Sample	16.22	1241	.13
John Joynt, Lucknow, Ontario, Canada.				
Pure Hardwood Ashes	Sunderland	8.98†	31	17.85
Pure Hardwood Ashes	Cushman	9.36†	35	16.21
Pure Hardwood Ashes	Sunderland	9.18†	77	16.79
Pure Hardwood Ashes	Sunderland	10.72†	84	20.49
Pure Hardwood Ashes	Sunderland	8.01†	85	24.08
Pure Hardwood Ashes	N. Hadley	9.15†	106	21.68
Pure Hardwood Ashes	N. Hadley	7.83†	137	18.57
Pure Hardwood Ashes	Sunderland	9.19†	206	21.36
Pure Hardwood Ashes	Sunderland	7.72†	346	17.57
Pure Hardwood Ashes	Sunderland	10.18†	347	19.50
Pure Hardwood Ashes	Boston	8.86†	476	22.36
Pure Hardwood Ashes	Boston	9.07†	556	25.33
Pure Hardwood Ashes	Fitchburg	9.92†	808	14.96
Pure Hardwood Ashes	Sunderland	8.89†	1271	23.97
Geo. L. Munroe & Sons, Oswego, N. Y.				
Pure Unleached Wood Ashes	Bradstreet	6.94†	122	8.15
GROUND ROCK				
New Mineral Fertilizer Co., 11 S. M'k't St., Boston, Mass.				
New Mineral Fertilizer	Boston	68	565	.10
	S. Sudbury		1096	

† The potash in ashes is largely present as carbonate and has been valued at 8 cts. per pound. The lime in ashes has been valued at the same price as for agricultural lime, namely .004 cts. per pound of actual calcium oxide.

Fertilizers Furnishing Phosphoric Acid and Potash.

Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.		
			Total.		Available.				
Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Calcium Oxide (CaO) in 100 lbs.
.57	6.35	1.91	8.83	9.00	6.92	6.00	15.49*	15.00	—
7.69	2.70	.15	10.54	11.00	10.39	10.00	2.89	2.00	—
7.97	2.67	.20	10.84	11.00	10.64	10.00	2.38	2.00	—
1.51	12.80	.05	14.36	—	14.31	12.00	18.16*	15.00	—
.29	14.21	.68	15.18	—	14.50	12.00	15.78*	15.00	
—	—	—	1.33	1.33	—	—	7.40	7.34	43.08
—	—	—	1.32	1.00	—	—	3.56	3.00	30.77
—	—	—	1.60	1.00	—	—	3.71	3.00	28.80
—	—	—	1.34	1.00	—	—	3.71	3.00	28.73
—	—	—	1.43	1.00	—	—	4.70	3.00	27.52
—	—	—	1.53	1.00	—	—	3.15	3.00	23.74
—	—	—	1.47	1.00	—	—	4.03	3.00	20.86
—	—	—	1.10	1.00	—	—	3.10	3.00	26.23
—	—	—	1.16	1.00	—	—	3.91	3.00	26.52
—	—	—	.99	1.00	—	—	3.52	3.00	17.50
—	—	—	1.31	1.00	—	—	4.37	3.00	28.42
—	—	—	1.56	1.00	—	—	3.33	3.00	30.50
—	—	—	1.38	1.00	—	—	3.95	3.00	22.24
—	—	—	1.48	1.00	—	—	4.12	3.00	28.61
—	—	—	1.35	1.00	—	—	3.53	3.00	28.58
—	—	—	.82	.50	—	—	2.13	1.00	37.02
—	—	—	.13	.23	—	—	.16**	2.09	—

* Nos. 671–848–1067 Chlorine .80% equivalent to 1.06% potash, 14.43% potash as sulfate.
" 1206 " 1.73% " " 2.30% " 4.24% " " "
11.62% potash as carbonate, 19.15% total potash.
* No. 1270 Chlorine 1.29% equivalent to 1.71% potash, .87% potash as sulfate, 13.20% potash as carbonate.
** Total nitrogen .11%.

Fertilizers for Private Use, Officially Collected (Not Registered).

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost of Like Amounts of Nitrogen Phos. Acid and Potash in Unmixed Materials.	Laboratory Number.	Moisture.
American Agric. Chem. Co., Boston, Mass.				
Bradley's Excelsior Fish and Potash	Bradstreet	$18.95	79	6.57
Armour Fertilizer Co., Baltimore, Md.				
Special Mixture	Chicopee	32.00	768	9.33
Robert Ball, Montague, Mass.				
Home Mixed Fertilizer	Montague	36.26	1269	5.85
Berkshire Fertilizer Co., Bridgeport, Ct.				
Special Mixture 4-8-7	Sunderland	23.94	76	7.95
Special Mixture	N. Hadley	29.32	98	13.38
Special Mixture	N. Hadley	44.46	228	8.54
Special Mixture	N. Hadley	35.53	230	9.45
Special Mixture	N. Hadley	32.96	126	9.51
Special Mixture	Seekonk	30.81	388	10.02
Theodore Eaton, Box 240, Brookfield, Mass.				
Corn Phosphate	Brookfield	15.13	1276	9.92
Potato Phosphate	Brookfield	17.22	1277	10.46
Fertilizer Materials Supply Co., New York City.				
4—7—10	Gt. Barrington.	27.55	1192	6.40
No. 1 Potato and General Truck Fertilizer	Gt. Barrington.	29.71	1193	8.47
Lister's Agric. Chem. Works, Newark, N. J.				
Complete Tobacco Manure with Carbonate	Sunderland	28.12	57	7.33
W. W. Maloney, Southwick, Mass.				
Tobacco Starter	Southwick	35.85	1285	5.35
Tobacco Special	Southwick	27.25	1286	6.67
Mitchell Fertilizer Co., Tremley, N. J.				
Mitchell's Special Fertilizer	Seekonk	30.78	384	9.13
National Fertilizer Co., Boston, Mass.				
Chittenden's Special Formula	Sunderland	26.86	344	6.93
Olds & Whipple, Hartford, Ct.				
Special Mixture for Tobacco	N. Hadley	29.04	148	7.35
J. W. Sanborn, Pittsfield, N. H.				
Sanborn's Clover and Bean Fertilizer	Royalston	26.92	1176	4.97
F. E. Wells, So. Deerfield, Mass.				
Tobacco Fertilizer	So. Deerfield	35.77	1282	6.26
O. L. Wilcox, Montague, Mass.				
Special Mixture	Montague	39.40	1272	6.02
Wilcox Fertilizer, Mystic, Ct.				
Special Mixture	Agawam	29.22	1284	12.48
Berkshire Fertilizer Co., Bridgeport, Ct.				
Tankage	N. Hadley	30.15	151	9.18
Coe-Mortimer Co., New York City.				
Dry Ground Fish	Amherst	40.99	1250	10.13
State Farm, Bridgewater.				
Bone	Bridgewater	28.02	716	6.23
Stone Meal Fertilizer Co., Paterson, N. J.				
Stonemeal "O"	Amherst	2.42	1273	2.62
Stonemeal "P"	Amherst	1.62	1274	3.60
Stonemeal "H P"	Amherst	2.64	1275	3.12
The H. A. Stoothoff Co., Mt. Vernon, N. Y.				
Tobacco Dust	Boston	11.53	508	6.43

* No. 148 Chlorine .57% equivalent to .78% potash, 1.05% potash as sulphate, 3.69% potash as carbonate, 5.69% total potash.
No. 1176 Chlorine 1.86% equivalent to 2.46% potash, 9.21% potash as sulphate
" 1272 " .78% " " 1.03% " 12.88% " " "

† No. 151 Mechanical Analysis, Fine 40.24, Coarse 59.76
" 716 " " " 71.60 " 28.40

‡ No. 1273 Calcium oxid, 18.11% magnesium oxid, 4.02% valued same as in agricultural limes.
" 1274 " " 14.82% " " 2.56% " " " " " "
" 1275 " " 19.18% " " 4.33% " " " " " "

Fertilizers for Private Use, Officially Collected (Not Registered).

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.24	.16	.67	.50	2.57	2.47	1.28	3.28	2.02	6.58	5.00	4.56	4.00	5.56	4.00
2.92	.01	.70	.34	3.97	4.12	7.91	.53	.64	9.08	—	8.44	8.00	11.07	10.00
2.27	.52	.73	.43	3.95	6.00	.99	6.03	5.56	12.58	12.00	7.02	6.00	13.06*	11.00
1.20	—	2.14	.61	3.95	3.29	5.55	3.31	.15	9.01	8.00	8.86	—	7.54*	7.00
1.16	.85	1.23	.78	4.02	—	2.81	5.69	1.81	10.31	—	8.50	—	6.51*	—
.51	.86	3.56	1.68	6.61	7.33	.32	3.84	1.22	5.38	5.33	4.16	—	15.16*	5.43
.39	.33	3.22	1.42	5.36	5.50	1.02	7.53	1.40	9.95	9.50	8.55	7.50	7.60*	5.00
.37	.76	2.33	1.75	5.21	4.50	1.57	3.35	.28	5.20	4.00	4.92	3.00	6.28*	5.50
1.77	.67	.77	.49	3.70	—	7.25	2.01	.69	9.95	—	9.26	—	8.49*	—
.68	.36	.23	.29	1.56	—	4.06	3.70	1.91	9.67	—	7.76	—	2.23	—
.98	.39	.29	.35	2.01	—	3.25	3.56	2.40	9.21	—	6.81	—	3.47	—
2.03	.08	1.22	.64	3.97	3.30	1.28	3.97	3.50	8.75	7.00	5.25	—	8.16	10.00
2.37	.11	.82	.78	4.08	3.31	4.66	3.58	1.58	9.82	—	8.24	8.00	7.95	7.00
1.90	.58	1.05	.48	4.01	4.11	.57	4.53	2.27	7.37	5.00	5.10	4.00	5.52*	5.00
5.22	.49	1.13	.78	7.62	—	.77	3.37	1.12	5.26	—	4.14	—	3.47*	—
.36	.32	2.28	1.46	4.42	—	.70	4.25	.20	5.15	—	4.95	—	6.11*	—
2.26	.21	1.23	.56	4.26	4.11	6.31	1.93	1.20	9.44	9.00	8.24	8.00	8.37	8.00
.91	.27	.95	.44	2.57	2.47	5.46	4.52	1.40	11.38	11.00	9.98	10.00	7.95*	8.00
.72	.80	1.66	1.65	4.83	—	.26	3.37	.43	4.06	—	3.63	—	5.52*	—
1.93	—	.17	.20	2.30	2.00	.93	6.70	1.02	8.65	8.00	7.63	6.00	11.67*	10.50
.90	.82	2.07	1.37	5.16	—	.29	5.70	1.28	7.27	—	5.99	—	9.51*	—
1.61	1.74	.78	.42	4.55	—	.11	7.41	4.59	12.11	—	7.52	—	13.91*	—
.88	.25	1.17	.35	2.65	—	8.01	2.10	.89	11.09	—	10.11	—	9.59*	—
.39	4.19	2.07	1.60	8.25	7.50	—	—	—	3.70†	6.00	—	—	—	—
.59	.48	4.96	2.55	8.58	—	—	—	—	8.34	—	—	—	—	—
.01	.37	.52	.38	1.28	—	—	—	—	30.38†	—	—	—	—	—
—	—	—	—	.09	—	—	—	—	.23	—	—	—	.27‡	—
—	—	—	—	.06	—	—	—	—	.20	—	—	—	.04‡	—
—	—	—	—	.06	—	—	—	—	.20	—	—	—	.54‡	—
—	.90	.41	.99	2.30	—	.13	.27	.08	.48	—	.40	—	2.42	—

* No. 1269 Chlorine .59% equivalent to .79% potash, 12.27% potash as sulfate.
" 76 " 2.18% " " 2.88% " 4.66% " " "
" 98 " 1.78% " " 3.27% " 4.14% " " "
" 228 " 1.41% " " 1.88% " 13.28% " " "
" 126 " .67% " " .89% " .71% " " " 4.68% potash as carbonate.
" 230 " 1.06% " " 1.40% " 6.20% " " "
" 388 " 1.53% " " 2.03% " 6.46% " " "
" 57 " .30% " " .41% " .91% " " "

* No. 1285 Chlorine .16% equivalent to .21% potash, 3.26% potash as sulfate.
No. 1286 " .13% " " .17% " 5.94% " " "
No. 1282 " .22% " " .30% " 9.21% " " "
No. 1284 " .37% " " .49% " 9.10% " " "
4.20% potash as carbonate. 5.60% total potash.

*No. 344 Chlorine .94% equivalent to 1.27% potash, 6.68% potash as sulfate.

Fertilizers for Private Use, Officially Collected (Not Registered).

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.
NITROGEN COMPOUNDS				
American Cyanamid Co., Nashville, Tenn.				
Calcium Cyanamid	Amherst	$56.16	1260	1.74
Baugh & Sons Co., Baltimore, Md.				
Nitrate of Soda	Chicopee	55.87	773	1.90
Baker Castor Co., New York City.				
Pure Castor Pomace	Seekonk	18.00	366	8.92
Coe-Mortimer Co., New York City.				
Sulphate of Ammonia	Amherst	77.70	1252	.20
S. P. Davis, Little Rock, Ark.				
Good Luck Cottonseed Meal	Sunderland	24.28	1130	8.71
East St. Louis Cotton Oil Co., Nat. Stock Yards, Ill.				
Choice Cottonseed Meal	Westfield	26.44	970	7.41
Mitchell Fertilizer Co., Tremley, N. J.				
Nitrate of Soda	Seekonk	56.32	383	1.70
G. B. Robinson, Jr., 18 Broadway, New York City.				
Cottonseed Meal	N. Hadley	26.72	967	7.73
W. Newton Smith, Baltimore, Md.				
Cottonseed Meal	N. Hatfield	26.48	1246	9.01
POTASH COMPOUNDS				
Baugh & Sons Co., Baltimore, Md.				
Sulphate of Potash	Chicopee	53.30	772	1.03
Coe-Mortimer Co., New York City.				
L. G. Sulphate of Potash	Amherst	29.86	1255	2.71
Kainit	Amherst	14.15	1259	2.26
Olds & Whipple, Hartford, Ct.				
Muriate of Potash	N. Hadley	44.81	117	.80
PHOSPHORIC ACID COMPOUNDS				
American Agric. Chem. Co., Boston, Mass.				
Plain Super-phosphate	Lawrence	15.02	550	9.35
Ground Untreated Phosphate Rock	Pratts Junction	11.70	947	1.15
Olds & Whipple, Hartford, Ct.				
Acid Phosphate	N. Hadley	19.87	119	22.95
H. J. Baker & Bro., New York City.				
Basic Slag	Amherst	11.76	1289	.14
Coe-Mortimer Co., New York City.				
Dissolved Bone Black	Amherst	16.18	1258	15.27
Dominion Iron & Steel Co., Cape Breton, N. S.				
Basic Slag	Amherst	10.45	1265	.14
Fertilizer Materials Supply Co., New York City.				
Basic Slag	Gt. Barrington	12.44	1198	.18
Munro & Co., New York City.				
Basic Slag	Marlboro	12.65	1072	.19
Nitrate Agencies Co., New York City.				
Dissolved Bone Black	Amherst	16.04	1263	16.80
Olds & Whipple, Hartford, Ct.				
Precipitated Bone Phosphate	Hatfield	31.13	217	6.43
" " "	Northampton		727	
" " "	N. Hadley		730	
J. W. Sanborn, Pittsfield, N. H.				
Basic Slag	Royalston	11.78	1180	.08

Fertilizers for Private Use, Officially Collected (Not Registered).

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
—	12.87	.32	1.59	14.78	—	—	—	—	—	—	—	—	—	—
15.10	—	—	—	15.10	—	—	—	—	—	—	—	—	—	—
—	.67	1.98	1.85	4.50	4.50	—	—	—	—	—	—	—	—	—
21.00	—	—	—	21.00	—	—	—	—	—	—	—	—	—	—
—	—	—	—	6.07	6.50	—	—	—	—	—	—	—	—	—
—	—	—	—	6.61	6.58	—	—	—	—	—	—	—	—	—
15.22	—	—	—	15.22	15.00	—	—	—	—	—	—	—	—	—
—	—	—	—	6.68	6.50	—	—	—	—	—	—	—	—	—
—	—	—	—	6.62	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	50.76	—
—	—	—	—	—	—	—	—	—	—	—	—	—	28.44	—
—	—	—	—	—	—	—	—	—	—	—	—	—	13.48	—
—	—	—	—	—	—	—	—	—	—	—	—	—	52.72	—
—	—	—	—	—	—	13.59	3.19	.59	17.37	—	16.78	16.00	—	—
—	—	—	—	—	—	—	—	—	29.26	30.20	—	—	—	—
—	—	—	—	—	—	4.18	19.59	1.10	24.87	—	23.77	20.00	—	—
—	—	—	—	—	—	—	13.98	1.44	15.42	—	13.98	—	—	—
—	—	—	—	—	—	15.81	2.41	.06	18.28	—	18.22	—	—	—
—	—	—	—	—	—	—	12.77	.83	13.60	—	12.77	—	—	—
—	—	—	—	—	—	—	14.61	1.85	16.46	—	14.61	14.00	—	—
—	—	—	—	—	—	—	15.15	1.33	16.48	17.00	15.15	—	—	—
—	—	—	—	—	—	15.92	2.01	.26	18.19	—	17.93	—	—	—
—	—	—	—	—	—	.57	38.02	.51	39.10	—	38.59	38.00	—	—
—	—	—	—	—	—	—	13.20	3.06	16.26	—	13.20	—	—	—

Ground Bone.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.
American Agric. Chem. Co., Boston, Mass.				
Fine Ground Bone	Plymouth		460	
" " "	S. Amherst	$26 37	708	6.89
Farquhar's Pure Ground Bone	Boston	26 20	570	5.56
Armour Fertilizer Works, Baltimore, Md.				
Bone Meal	Amherst	27 70	74	2.70
Beach Soap Co., Lawrence, Mass.				
Fertilizer Bone	Lawrence	31.91	560	4.98
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Fresh Ground Bone	Dighton		312	
" " " "	Taunton		317	
" " " "	Beverly	26.22	644	4.81
" " " "	Middleboro		690	
" " " "	Northampton		795	
E. D. Chittenden Co., Bridgeport, Ct.				
Ground Bone	Leominster	23.59	910	5.45
" "	Southbridge		1138	
Coe-Mortimer Co., New York City,				
E. Frank Coe's XXX Fine Ground Bone	Westford	25.52	1229	5.44
Ground Bone	Amherst	26.63	1253	5.34
John C. Dow Co., Boston, Mass.				
Dow's Pure Ground Bone	Boston		518	
" " " "	"	27.85	548	5.60
" " " "	Fitchburg		823	
Essex Fertilizer Co., Boston, Mass.				
Essex Ground Bone	Taunton	28.52	264	3.77
Thomas Hersom & Co., New Bedford, Mass.				
Pure Bone Meal	New Bedford	28.09	256	3.87
Home Soap Co., Worcester, Mass.				
Pure Ground Bone	N. Grafton	28.93	932	9.71
International Agric. Corp. Buffalo, N. Y.				
Bone Meal	Pepperell	27.16	1019	6.89
" "	Lee		1069	
Lowell Fertilizer Co., Boston, Mass.				
Ground Bone	Hatfield		219	
" "	Fall River		332	
" "	Chicopee	29.58	771	3.79
" "	N. Grafton		925	
" "	Framingham		975	
" "	Worcester		814	
Geo. E. Marsh & Co., Lynn, Mass.				
Marsh's Pure Ground Bone	Lynn	29.62	588	5.04
" " " "	Natick		613	
D. M. Moulton, Monson, Mass.				
Ground Bone	Monson	26.56	1114	8.33
National Fertilizer Co., Boston, Mass.				
Chittenden's Fine Ground Bone	Bradstreet		70	
" " " "	Sunderland		340	
" " " "	"	27.00	542	6.24
" " " "	Marlboro		1076	
Nitrale Agencies Co., New York City.				
Ground Bone	Seekonk	27.84	387	6.42
Ground Bone	Three Rivers	26.50	1102	8.17
Rogers Manufacturing Co., Rockfall, Ct.				
Pure Fine Ground Bone	Plainville		237	
" " " "	Amherst	34.20	647	10.18
" " " "	Norwood		877	
Pure Knuckle Bone Flour	Brookfield	33.95	1137	8.79

Ground Bone.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
.12	.43	1.43	.53	2.51	2.47	—	—	—	22.50	22.88	—	—	72.32	27.68
.18	.55	1.23	.62	2.58	2.47	—	—	—	22.71	22.88	—	—	59.10	40.90
.12	.34	.98	.80	2.24	2.47	—	—	—	26.28	22.50	—	—	58.36	41.64
—	1.69	1.29	1.17	4.15	2.67	—	—	—	22.20	20.00	—	—	70.89	29.11
.13	.63	1.24	.57	2.57	2.47	—	—	—	22.48	22.88	—	—	64.46	35.54
—	.61	.88	.68	2.17	2.47	—	—	—	20.87	20.60	—	—	64.52	35.48
.19	.75	1.11	.54	2.59	2.47	—	—	—	21.35	22.28	—	—	66.70	33.30
—	.57	1.16	.76	2.49	2.47	—	—	—	23.31	22.28	—	—	66.00	34.00
.10	.64	.98	.89	2.61	2.00	—	—	—	24.52	24.00	—	—	62.84	37.16
.08	.60	1.16	.65	2.49	2.46	—	—	—	26.00	23.00	—	—	61.65	38.35
.16	1.00	.69	.50	2.35	2.00	—	—	—	25.26	24.00	—	—	76.26	23.74
.32	.64	1.19	.65	2.80	2.00	—	—	—	26.33	28.00	—	—	43.07	56.93
.25	.84	1.34	.97	3.40	2.40	—	—	—	20.31	22.00	—	—	57.59	42.41
.08	.68	1.17	.75	2.68	2.40	—	—	—	25.61	23.00	—	—	76.74	23.26
.07	.87	1.11	.77	2.82	2.46	—	—	—	26.20	28.00	—	—	57.96	42.04
.09	.58	2.58	1.03	4.28	4.26	—	—	—	18.24	18.96	—	—	18.13	81.87
.42	.52	1.17	.44	2.55	2.47	—	—	—	23.57	22.88	—	—	64.86	35.14
—	.80	1.25	.62	2.67	2.46	—	—	—	23.73	22.88	—	—	71.40	28.60
.15	.30	1.21	.50	2.16	2.46	—	—	—	24.16	22.88	—	—	74.72	25.28
—	.25	2.61	.76	3.62	3.50	—	—	—	26.35	25.00	—	—	88.79	11.21
.10	.11	2.59	1.01	3.81	3.80	—	—	—	26.66	24.00	—	—	67.42	37.58

Bone and Tankage.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.
BONE (Concluded)				
Rogers & Hubbard, Middletown, Ct.				
Hubbard's "Bone Base" Pure Raw Knuckle Bo. Flour	E. Milton	$33 34	722	9 20
" " " " " " " "	Amherst		1292	8.72
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
Swift-Sure Bone Meal	Sunderland	35 86	345	3 02
Springfield Rendering Co, Springfield, Mass.				
Ground Bone	N. Amherst	29 28	65	3.09
Ground Bone	Springfield	31 11	843	5 28
T. L. Stetson, Randolph, Mass.				
Pure Ground Bone	Man. Sample	29 20	534	8 62
" " "	Brockton		908	
Whitman and Pratt Rendering Co., Lowell, Mass.				
W. & P. Pure Ground Bone	N. Chelmsford	28 74	952	6 20
Wilcox Fertilizer Works, Mystic, Ct.				
Wilcox Pure Ground Bone	New Bedford	28 63	254	4 64
Sanford Winter Co., Brockton, Mass.				
Pure Ground Bone	Brockton	34 20	1169	7 79
DISSOLVED BONE				
W. H. Abbott, Holyoke, Mass.				
Abbott's Animal Fertilizer	Sunderland	27 15	544	8.30
" " "	Whately		582	
" " "	Amherst		1293	7 61
Mapes' Formula & Peruvian Guano Co., N. Y. City.				
Mapes' Dissolved Bone	Conway	23 70	1188	6 44
TANKAGE				
American Agric. Chem. Co., Boston, Mass.				
Ground Tankage	N. Hadley	31 70	499	7.34
Berkshire Fertilizer Co., Bridgeport, Ct.				
Tankage	N. Hadley	32 44	143	7 62
Tankage	N. Hadley	32 87	167	8.62
Bowker's Fertilizer Co., Boston, Mass.				
Bowker's Fine Ground Bone Tankage	Northampton		796	
" " " " "	Ayer	34.46	935	5.93
" " " " "	Charlton		993	
Coe-Mortimer Co., New York City.				
Ground Tankage 9-20	Northfield	35 45	1212	6.34
Tankage	Amherst	38 91	1254	5.80
Thomas Hersom & Co., New Bedford, Mass.				
Meat and Bone	New Bedford	31 33	250	6.05
Lowell Fertilizer Co., Boston, Mass.				
Tankage	Fall River		338	
"	Concord	32 00	434	6 67
"	Fitchburg		840	
Geo. E. Marsh Co., Lynn, Mass.				
Marsh's Dry Ground Tankage	Lynn	25 28	537	7.54
Nitrate Agencies Co., New York City.				
Ground Tankage	Bridgewater		718	
" "	Framingham	31 11	976	6 27
" "	Southwick		1118	
Tankage	Heath		1296	5 05
Springfield Rendering Co., Springfield, Mass.				
Ground Tankage	N. Amherst	37 80	67	3.72
Ground Tankage	N. Hadley	37 62	496	4 34
Brightwood Tankage	Westfield	36 00	1281	4 74

Bone and Tankage.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
				Total.					Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
.07	—	2.79	1 09	3 95	3 82	—	—	—	25 46	24 70	—	—	64 13	35.87
—	.03	3 04	90	3 97	3 82	—	—	—	25 87	24.70	—	—	55 08	44.92
09	.86	2 35	1 35	4 65	4.53	—	—	—	25.46	20.00	—	—	65.15	34.85
—	.91	.65	.54	2 10	2 47	—	—	—	27.32	23.00	—	—	87 36	12.64
.07	38	1 73	.82	3 00	2.47	—	—	—	26.18	23 00	—	—	75.34	24.66
.13	.14	2.79	1.13	4 19	4.20	—	—	—	21.94	20.66	—	—	22 93	77 07
.48	.92	.66	.60	2 66	2.46	—	—	—	25.69	25.00	—	—	59.15	40.85
.14	.94	.95	.57	2.60	2.46	—	—	—	26 38	22.00	—	—	49.90	50.10
.37	2 30	1 80	1.11	5.58	3.25	—	—	—	20.28	24.15	—	—	50 14	49.86
.33	.81	1.86	.74	3.74	3.00	1.28	10.66	7.88	19.82	15.00	11.94	10.00	—	—
—	1 06	2.09	.89	4.04	3.00	1 21	15.02	4 18	20.41	15.00	16.23	10.00	—	—
.28	.75	.83	.54	2.40	2.06	3.70	13.60	.97	18.27	12.00	17.30	—	—	—
.57	1 35	2.46	1 21	5.59	4.94	—	—	—	15.66	13.73	—	—	65.60	34.40
.41	4 20	2 30	1.63	8.54	7.50	—	—	—	4 69	6.00	—	—	48.42	51.58
.32	4 02	2.40	1 98	8.72	7.50	.77	2.98	.64	4 39	6 00	3.75	—	48 92	51.08
.19	2.91	1.62	1.24	5.96	4.94	—	—	—	17.66	13.73	—	—	64.55	35.45
.17	1 12	4 27	1 49	7 05	7.40	—	—	—	13 92	9.15	—	—	64.73	35.27
.60	.52	5 43	1 97	8.52	7.40	—	—	—	11.55	9.15	—	—	66 01	33.99
.11	.73	2.73	1 54	5.11	4.00	—	—	—	17.48	16.00	—	—	64.46	35.54
.21	2.41	2.24	1 30	6 16	4.94	—	—	—	14.36	14.00	—	—	54.57	45.43
.25	1.40	1.90	1 32	4 87	5.00	—	—	—	10 69	12.00	—	—	64.16	35.84
.21	1 59	2.36	1.09	5 25	5.75	—	—	—	17.78	13.73	—	—	48.83	51.17
—	.63	3.78	1 55	5 96	5.75	—	—	—	13.57	13.73	—	—	62.67	37.33
.28	3 59	2.31	1 15	7.33	7 00	—	—	—	14 62	10.00	—	—	76.20	23.80
.20	3 20	2.84	1.80	8.04	7.00	—	—	—	12.73	10.00	—	—	59.56	40.44
.40	3 65	2.22	1 03	7 30	7 00	—	—	—	14.34	10.00	—	—	55.69	44.31

Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.
TANKAGE—(Concluded)				
Whitman and Pratt Rendering Co., Lowell, Mass.				
Tankage	N. Chelmsford	$31 66	953	5 97
J. M. Woodard, Greenfield, Mass.				
Woodard's Unground Tankage	Greenfield	29 43	1186	5 04
Worcester Rendering Co., Auburn, Mass.				
Ground Tankage	Worcester	34 32	815	7 30
" "	Framingham		979	
DRY GROUND FISH				
American Agric. Chem. Co., Boston, Mass.				
Dry Ground Fish	Bradstreet	39 42	69	8 87
" " "	Sunderland		190	
" " "	"		196	
" " "	Hadley		1066	
Berkshire Fertilizer Co., Bridgeport, Ct.				
Berkshire Dry Ground Fish	N. Hadley	41 78	118	9 49
" " " "	"		132	
" " " "	"		818	
" " " "	Worcester		828	
Berkshire Dry Ground Fish	N. Hadley	40 13	166	11 10
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Dry Ground Fish	Northampton	38 05	794	8 33
" " " "	Deerfield		1187	
E. D. Chittenden Co., Bridgeport, Ct.				
Chittenden's Dry Ground Fish	N. Amherst	33 52	415	7 36
International Agric. Corp. Buffalo, N. Y.				
Buffalo Dry Ground Fish	N. Amherst	28 74	157	13 67
" " " "	Easthampton		411	
" " " "	N. Hatfield		682	
Buffalo Dry Ground Fish	Hockanum	29.85	620	10 53
Lister's Agric. Chem. Works, Newark, N. J.				
Lister's Fish Scrap	Hadley	35.92	353	8 82
National Fertilizer Co., New York City.				
Chittenden's Dry Ground Fish	Sunderland	38.58	187	8.45
" " " "	"		202	
" " " "	"		214	
" " " "	"		247	
" " " "	"		341	
Olds and Whipple, Hardford, Ct.				
O. & W. Dry Ground Fish	N. Hadley	39.05	139	10.33
Rogers Manf. Co., Rockfall, Ct.				
Dry Ground Fish	Deerfield	36 62	1185	13.47
Sanderson Fertilizer and Chem. Co., New Haven, Ct.				
Sanderson's Fine Ground Fish	Sunderland	38 82	66	10.36
" " " "	Agawam		1127	
Wilcox Fertilizer Works, Mystic, Ct.				
Wilcox Dry Ground Fish	Amherst	40.09	47	6.88
" " " "	Deerfield		92	
" " " "	N. Hadley		158	
" " " "	"		170	
" " " "	"		238	
" " " "	New Bedford		255	
" " " "	Fall River		297	
Wilcox Dry Ground Acidulated Fish	Fall River	36.52	292	14.50
" " " " "	S. Deerfield		1057	

Tankage and Dry Ground Fish.

Nitrogen in 100 lbs.						Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
									Total.		Available.			
As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
16	.97	2.75	1.63	5.51	5.35	—	—	—	16.54	13.73	—	—	58.42	41.58
.25	1.78	2.36	.94	5.33	4.50	—	—	—	18.47	18.00	—	—	8.25	91.75
.26	3.77	1.71	.96	6.70	7.00	—	—	—	14.52	12.00	—	—	59.50	40.50
.53	.72	4.95	2.26	8.46	8.23	—	6.10	1.76	7.86	6.00	6.10	—	—	—
.45	56	5.73	2.23	8.97	8.23	—	6.71	1.33	8.04	6.00	6.71	—	—	—
.39	.44	5.24	2.54	8.61	8.23	1.06	5.14	1.58	7.78	6.00	6.20	—	—	—
.50	.78	4.73	2.19	8.20	8.23	—	5.71	1.71	7.42	6.00	5.71	—	—	—
.83	3.41	2.29	1.09	7.62	8.00	—	3.42	.74	4.16	6.00	3.42	—	—	—
.71	.68	3.89	1.22	6.50	6.50	.48	2.79	.20	3.47	—	3.27	—	—	—
.72	.71	3.45	2.24	7.12	6.50	.45	1.03	.36	1.84	2.00	1.48	—	—	—
.76	.71	4.29	1.77	7.53	8.23	—	6.20	2.09	8.29	11.00	6.20	—	—	—
.52	.70	5.12	1.93	8.27	8.23	—	5.87	1.99	7.86	6.00	5.87	—	—	—
.87	.98	4.16	2.34	8.35	7.40	—	6.61	.89	7.50	5.50	6.61	4.50	—	—
.85	1.28	3.67	2.19	7.99	7.90	—	5.59	.48	6.07	5.50	5.59	—	—	—
38	.46	5.25	2.32	8.41	8.23	—	6.17	.59	6.76	6.00	6.17	—	—	—
16	04	5.87	2.89	8.96	8.24	—	4.51	1.61	6.12	6.00	4.51	4.00	—	—
76	1.31	3.61	2.29	7.97	7.81	—	5.53	.54	6.07	6.00	5.53	—	—	—

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.
SULFATE OF AMMONIA						
American Agric. Chem. Co., Boston, Mass.						
Sulfate of Ammonia	S. Amherst	\$76.08	1236	1.05	20.56	20.16
International Agric. Corp., Buffalo, N. Y.						
Sulfate of Ammonia	N. Amherst	74.96	325	3.01	20.26	20.50
Nitrate Agencies Co., New York City.						
Sulfate of Ammonia	Framingham	76.97	978	1.27	20.80	20.00
NITRATE OF SODA						
American Agric. Chem. Co., Boston, Mass.						
Nitrate of Soda	Amherst		73			
" " "	Sunderland		349			
" " "	Boston		490			
" " "	Sunderland	55.50	490	2.05	15.00	15.00
" " "	Boston		564			
" " "	Amherst		651			
" " "	Marlboro		1077			
Berkshire Fertilizer Co., Bridgeport, Conn.						
Nitrate of Soda	N. Hadley	54.39	103	2.55	14.70	14.80
Bowker Fertilizer Co., Boston, Mass.						
Bowker's Nitrate of Soda	Taunton		326			
" " " "	Dighton	54.32	329	2.05	14.68	15.00
" " " "	Fall River		337			
Coe-Mortimer Co., New York City.						
Nitrate of Soda	Northfield	55.43	1211	1.63	14.98	15.00
Essex Fertilizer Co., Boston, Mass.						
Nitrate of Soda	Taunton	56.24	309	2.60	15.20	15.00
International Agric. Corp., Buffalo, N. Y.						
Nitrate of Soda	N. Amherst	54.46	156	2.55	14.72	15.00
" " "	Hockanum		629			
Nitrate of Soda	Hockanum	55.13	623	1.04	14.90	15.00
Lister's Agric. Chem. Works. Newark. N. J.						
Nitrate of Soda	Fall River	55.50	399	1.74	15.00	15.00
Lowell Fertilizer Co., Boston, Mass.						
Nitrate of Soda	Hatfield		218			
" " "	Raynham		301			
" " "	N. Amherst	55.72	418	1.75	15.06	15.00
" " "	N. Hadley		502			
" " "	Hudson		1081			
Nitrate Agencies Co., New York City.						
Nitrate of Soda	Sunderland		213			
" " "	Seekonk		390			
" " "	Concord	54.46	435	2.76	14.72	15.00
" " "	Bridgewater		719			
Nitrate of Soda	Seekonk	57.50	364	2.01	15.54	15.00
Nitrate of Soda	Amherst	56.46	1262	1.54	15.26	15.00
Sanderson Fert. and Chem. Co., New Haven, Ct.						
Sanderson's Nitrate of Soda	New Bedford	56.16	241	1.53	15.18	15.00
" " " "	Gt. Barrington		1199			
Whitman & Pratt Rendering Co., Lowell, Mass.						
Nitrate of Soda	N. Chelmsford	55.72	951	1.97	15.06	15.00
Wilcox Fertilizer Works, Mystic, Ct.						
Wilcox Nitrate of Soda	New Bedford	55.50	248	2.15	15.00	15.00

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs.: As Nitrates and Ammoniates.	Water Soluble Organic.	Active Water Insoluble Organic.	Inactive Water Insoluble Organic.	Total: Found.	Total: Guaranteed.
DRIED BLOOD										
Amer. Agric. Chem. Co., Boston, Mass.										
High Grade Blood	Fall River	$43.80*	290	8.79	.62	2.28	4.95	2.06	9.91	9.87
" " "	Worcester		833							
Bowker Fert. Co., Boston, Mass.										
Bowker's Dried Blood	Northampton	42.85*	789	9.87	.38	.13	7.11	2.96	10.58	9.87
Coe-Mortimer Co., New York City.										
Dried Blood	Amherst	44.74*	1257	7.18	—	4.12	4.05	1.63	9.80	—
International Agric. Corp., Buffalo, N. Y.										
Dried Blood	Hockanum	41.55*	630	9.20	.27	.64	6.22	2.77	9.90	9.84
Lowell Fertilizer Co., Boston, Mass.										
Lowell Dried Blood	Concord	42.98*	758	7.95	.28	3.58	3.92	1.69	9.47	9.84
Nitrate Agencies Co., New York City.										
Dried Blood	Bridgewater	38.86*	715	11.25	.53	.58	5.89	2.53	9.53	9.87
" "	Heath	43.75*	1297	8.28	—	—	—	—	10.71	9.87
CALCIUM CYANAMID										
A. W. Higgins, Westfield, Mass.										
Calcium Cyanamid	Amherst		407							
" "	W. Springfield		766							
" "	N. Amherst	53.66	1061	1.02	—	13.08	.31	.73	14.12	12.00
" "	Southwick		1119							
" "	Feeding Hills	52.70	1280	2.73	—	—	—	—	13.87	12.00
COTTONSEED MEAL										
American Cotton Oil Co., New York City.										
Choice Cottonseed Meal	Hadley	25.56*	33	7.92	—	—	—	—	6.39	6.50
Choice Cottonseed Meal	N. Hadley	25.40*	91	9.37	—	—	—	—	6.35	6.50
Choice Cottonseed Meal	Sunderland	24.68*	484	10.22	—	—	—	—	6.17	6.50
Buckeye Cotton Oil Co., Cincinnati, O.										
Buckeye Cottonseed Meal	N. Hatfield	24.64	6	8.23	—	—	—	—	6.16	6.50
T. H. Bunch Com. Co., Little Rock, Ark.										
Old Gold Brand Cottonseed Meal	Hatfield	28.40	37	8.31	—	—	—	—	7.10	7.00
A. W. Higgins, Westfield, Mass.										
Dark Cottonseed Meal	Westfield	30.48	1243	8.17	—	—	—	—	7.62	7.50
" " "	Westfield	30.84	1244	8.54	—	—	—	—	7.71	7.50
Cottonseed Meal	Westfield	29.96	1248	7.70	—	—	—	—	7.49	7.50
" "	Feeding Hills	25.48	1278	7.30	—	—	—	—	6.37	—
Humphreys-Godwin Co., Memphis, Tenn.										
Dixie Brand Cottonseed Meal	Hatfield	31.36	1	7.74	—	—	—	—	7.84	7.40
Dixie Brand Cottonseed Meal	N. Hatfield	26.20	2	9.48	—	—	—	—	6.50	6.50
Dixie Brand Cottonseed Meal	Hatfield	24.60	3	9.25	—	—	—	—	6.15	6.50
Dixie Brand Cottonseed Meal	Bradstreet	26.08	5	8.42	—	—	—	—	6.77	6.50
Dixie Brand Cottonseed Meal	Hadley	24.36	8	9.37	—	—	—	—	6.09	6.50
Dixie Brand Cottonseed Meal	Sunderland	24.28	9	9.00	—	—	—	—	6.07	6.50
Dixie Brand Cottonseed Meal	Hadley	26.48	11	9.39	—	—	—	—	6.62	6.50

* Nos. 290–833 Phosphoric Acid 5.94%
" 789 " " .75%
" 1257 " " 7.92%
" 630 " " 2.78%
" 758 " " 7.28%
" 715 " " 1.06%
" 33 " " 2.58% Potassium Oxid 1.90%
" 91 " " 2.60% " " 1.74%
" 484 " " 2.50% " " 1.78%

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. As Nitrates and Ammoniates.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.
COTTONSEED MEAL (Concluded)							
Humphreys-Godwin Co., Memphis, Tenn.							
Dixie Brand Cottonseed Meal	Northampton	$26.32	12	8.18	—	6.58	6.50
Dixie Brand Cottonseed Meal	Sunderland	26.64	15	7.00	—	6.91	6.50
Dixie Brand Cottonseed Meal	Bradstreet	22.32	16	7.73	—	5.58	6.50
Dixie Brand Cottonseed Meal	N. Hadley	25.68	18	8.81	—	6.42	6.50
Dixie Brand Cottonseed Meal	E. Hadley	25.68	20	8.82	—	6.42	6.50
Dixie Brand Cottonseed Meal	Cushman	25.44	21	10.04	—	6.36	6.50
Dixie Brand Cottonseed Meal	Cushman	24.88	24	9.11	—	6.22	6.50
Dixie Brand Cottonseed Meal	Cushman	25.44	25	9.90	—	6.36	6.50
Dixie Brand Cottonseed Meal	Hadley	24.96	28	8.89	—	6.24	6.50
Dixie Brand Cottonseed Meal	Hadley	25.48	32	9.48	—	6.37	6.50
Dixie Brand Cottonseed Meal	Cushman	25.16	34	7.78	—	6.29	6.50
Dixie Brand Cottonseed Meal	Cushman	24.88	38	10.01	—	6.22	6.50
Dixie Brand Cottonseed Meal	Cushman	25.48	39	8.18	—	6.37	6.50
Dixie Brand Cottonseed Meal	Cushman	26.20	40	9.73	—	6.50	6.50
Dixie Brand Cottonseed Meal	Hadley	27.00	42	7.99	—	6.75	6.50
Dixie Brand Cottonseed Meal	Hatfield	28.84	215	7.64	—	7.21	7.40
Dixie Brand Cottonseed Meal	Amherst	24.44	379	8.91	—	6.11	6.50
Dixie Brand Cottonseed Meal	Amherst	24.96	380	9.48	—	6.24	6.50
Dixie Brand Cottonseed Meal	Sunderland	25.36	679	8.29	—	6.34	6.50
Dixie Brand Cottonseed Meal	Amherst	24.24	798	8.06	—	6.06	6.50
Dixie Brand Cottonseed Meal	Sunderland	27.84	1129	6.93	—	6.96	6.50
Dixie Brand Cottonseed Meal	Springfield	29.28	1249	7.80	—	7.32	—
Dixie Brand Cottonseed Meal	Hadley	31.16	4	8.13	—	7.79	7.75
Dixie Brand Cottonseed Meal	Sunderland	31.20	22	7.43	—	7.80	7.75
Dixie Brand Cottonseed Meal	Northampton	31.00	30	7.95	—	7.75	7.75
Dixie Brand Cottonseed Meal	Sunderland	31.32	36	8.32	—	7.83	7.75
Dixie Brand Cottonseed Meal	Hadley	31.00	41	8.09	—	7.75	7.75
Imperial Cotto Milling Co., Memphis, Tenn.							
Imperial Cotto Choice Cottonseed Meal	Northampton	24.80	787	7.80	—	6.20	6.50
Imperial Cotto Choice Cottonseed Meal	Amherst	24.48	968	6.39	—	6.12	6.50
Imperial Cotto Choice Cottonseed Meal	N. Hadley	26.12	969	7.23	—	6.53	6.50
Imperial Cotto Choice Cottonseed Meal	Deerfield	24.68	1011	7.50	—	6.17	6.50
Imperial Cotto Choice Cottonseed Meal	Florence	24.24	1123	7.59	—	6.06	6.50
Olds & Whipple, Hartford, Ct.							
Cottonseed Meal	Bradstreet	24.64	7	9.06	—	6.16	6.50
Cottonseed Meal	Hatfield	23.52	26	9.57	—	5.88	6.50
Cottonseed Meal	Bradstreet	23.52	27	9.64	—	5.88	6.50
J. E. Soper Co., Boston, Mass.							
Pioneer Cottonseed Meal	Southwick	27.16	10	7.60	—	6.79	6.50
Pioneer Cottonseed Meal	Southwick	26.24	13	7.83	—	6.56	6.50
Pioneer Cottonseed Meal	Southwick	26.00	14	8.14	—	6.50	6.50
Pioneer Cottonseed Meal	Southwick	26.00	17	7.12	—	6.50	6.50
Pioneer Cottonseed Meal	Southwick	26.08	19	7.43	—	6.52	6.50
Pioneer Cottonseed Meal	Southwick	27.64	23	8.47	—	6.91	6.50
Pioneer Cottonseed Meal	Southwick	28.32	29	8.02	—	7.08	6.50
CASTOR POMACE							
Olds & Whipple, Hartford, Ct.							
O. & W. Castor Pomace	Hatfield	20.24	1209	8.05	—	5.06	5.00

Note—Cottonseed meal contains on the average 2 to 3 per cent of phosphoric acid and from 1.50 to 2.50 percent of potash of which about 1.28 percent is water soluble.

Note—Castor pomace contains on the average 2.12 per cent of phosphoric acid and 1.20 per cent. potash

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
HIGH GRADE SULFATE OF POTASH						
American Agric. Chem. Co., Boston, Mass.						
H. G. Sulfate of Potash	Bradstreet		81			
" " " "	Sunderland		194			
" " " "	"		210			
" " " "	Fall River	$53.00	288	1.45	50.48	48.00
" " " "	Boston		481			
" " " "	Sunderland		543			
Berkshire Fertilizer Co., Bridgeport, Ct.						
H. G. Sulfate of Potash	Bradstreet	52.37	88	2.34	49.88	48.00
H. G. Sulfate of Potash	N. Hadley	53.05	152	1.88	50.52	48.00
H. G. Sulfate of Potash	N. Hadley	52.92	162	2.48	50.40	48.00
Bowker Fertilizer Co., Boston, Mass.						
Bowker's H. G. Sulfate of Potash	Northampton	50.82	788	2.05	48.40	48.00
" " " " "	Springfield		857			
Coe-Mortimer Co., New York City.						
Sulfate of Potash	N. Hadley	51.87	494	2.50	49.40	48.00
German Kali Works, Baltimore, Md.						
Sulfate of Potash	Lawrence		549			
" " "	Amherst	51.37	649	1.52	49.40	48.00
" " "	Worcester		879			
International Agric. Corp. Buffalo, N. Y.						
Sulfate of Potash	Hockanum	52.63	619	.76	50.12	48.00
Sulfate of Potash	Hockanum	52.42	627	2.25	49.92	48.00
Lowell Fertilizer Co., Boston, Mass.						
Sulfate of Potash	Hatfield	49.85	216	2.30	47.48	48.00
Nitrate Agencies Co., New York City.						
Sulfate of Potash	Sunderland		212			
" " "	Amherst		406			
" " "	Bridgewater		717			
" " "	Fitchburg		810			
" " "	Framingham	52.16	980	.95	49.68	48.00
" " "	Southbridge		1016			
" " "	Southwick		1120			
" " "	S. Williamstown		1201			
Sulfate of Potash	Amherst	52.42	1264	.95	49.92	48.00
Olds and Whipple, Hartford, Ct.						
Sulfate of Potash	Northampton	52.42	728	.87	49.92	48.00
" " "	N. Hadley		729			
Whitman & Pratt Rendering Co., Lowell, Mass.						
Sulfate of Potash	N. Chelmsford	51.87	959	2.52	49.40	48.00
Wilcox Fertilizer Works, Mystic, Ct.						
Wilcox H. G. Sulfate of Potash	New Bedford	52.04	240	1.12	49.56	48.69
SULFATE OF POTASH-MAGNESIA						
American Agric. Chem. Co., Boston, Mass.						
Double Manure Salt	Sunderland	28.35	489 *	4.70	27.00	26.00
" " "	Conway		1182			
Berkshire Fertilizer Co., Bridgeport, Ct.						
Double Sulfate of Potash	Sunderland	27.09	487	2.32	25.80	25.00
Bowker Fertilizer Co., Boston, Mass.						
Double Manure Salt	Northampton	30.20	797*	6.62	28.76	26.00
Olds & Whipple, Hartford, Ct.						
O. & W. Double Manure Salt	N. Hadley	28.43	1207*	6.95	27.08	26.00
Ross Bros'. Co., Worcester, Mass.						
Double Sulfate of Potash-Magnesia	Worcester	28.81	836	11.75	27.44	25.00

* Nos. 489-1182 Magnesia Oxid 6.98% Insoluble Matter 14.28%
" 797 " " 8.02% " " 7.64%
" 1207 " " 6.95% " " 13.29%

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
MURIATE OF POTASH						
American Agric. Chem. Co., Boston, Mass.						
Muriate of Potash	Plainville		235			
" " "	Sunderland		283			
" " "	Fall River		291			
" " "	Boston		479			
" " "	N. Hadley	42.53	498	2.00	50.04	49.00
" " "	Boston		563			
" " "	N. Amherst		645			
" " "	W. Upton		926			
" " "	Marlboro		1074			
Berkshire Fertilizer Co., Bridgeport, Ct.						
Muriate of Potash	Bradstreet	42.50	90	2.93	50.00	50.00
Muriate of Potash	N. Hadley	43.82	97	2.93	51.56	50.00
" " "	"		168			
Muriate of Potash	Somerset	44.95	1267	.48	52.88	50.00
Bowker Fertilizer Co., Boston, Mass.						
Bowker's Muriate of Potash	Dighton		311			
" " " "	Taunton		322			
" " " "	Concord	42.98	759	1.78	50.56	49.00
" " " "	Northampton		790			
" " " "	Charlton		994			
Coe-Mortimer Co., New York City.						
Muriate of Potash	Agawam	43.11	1125	2.18	50.72	49.00
German Kali Works, Baltimore, Md.						
Muriate of Potash	Lawrence	43.76	553	1.16	51.48	48.00
" " "	Worcester		875			
International Agric. Corp., Buffalo, N. Y.						
Muriate of Potash	Easthampton	43.62	410	2.68	51.32	48.00
Lowell Fertilizer Co., Boston, Mass.						
Muriate of Potash	N. Amherst	41.68	417	4.83	49.04	50.00
Muriate of Potash	Bellerica	42.23	585	1.85	49.68	50.00
Nitrate Agencies Co., New York City.						
Muriate of Potash	Sunderland		211			
" " "	Bridgewater		721			
" " "	Fitchburg		809			
" " "	Framingham	43.48	1056	2.92	51.16	50.00
" " "	N. Amherst		1070			
" " "	Southwick		1122			
Muriate of Potash	Seekonk	41.79	382	1.55	49.16	50.00
Muriate of Potash	Amherst	42.60	1261	1.10	50.12	50.00
Muriate of Potash	Heath	43.59	1294	1.61	51.28	50.00
Sanderson Fert. and Chem. Co., New Haven, Ct.						
Sanderson's Muriate of Potash	Sunderland	41.72	175	3.71	49.08	49.00
Whitman & Pratt Ren. Co., Lowell, Mass.						
Muriate of Potash	N. Chelmsford	41.99	950	1.71	49.40	50.00
Wilcox Fertilizer Works, Mystic, Ct.						
Wilcox Muriate of Potash	New Bedford	43.79	258	.58	51.52	50.56
" " " "	Dighton		309			
KAINIT						
Bowker Fertilizer Co., Boston, Mass.						
Bowker's Genuine German Kainit	Springfield	12.13	842	3.22	14.28	12.00
German Kali Works, Baltimore, Md.						
Kainit	Manf. Sample	12.98	1235	4.14	15.28	12.00
Nitrate Agencies Co., New York City.						
Kainit	Framingham	11.19	977	7.76	13.16	12.00
Wilcox Fertilizer Works, Mystic, Ct.						
Wilcox Kainit	New Bedford	11.66	257	6.14	13.72	12.00

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.
DISSOLVED BONE BLACK											
Amer. Agric. Chem. Co., Boston, Mass.											
Dissolved Bone Black	Boston	$14.37	524	12.69	12.86	2.52	1.94	17.32	16.00	15.38	15.00
" " " "	Worcester		839								
Bowker Fert. Co., Boston, Mass.											
Bowker's Dissolved Bone Black	Boston	14.03	576	11.13	12.05	3.08	1.81	16.94	16.00	15.13	15.00
Lowell Fert. Co., Boston, Mass.											
Dissolved Bone Black	Raynham	15.37	278	12.83	12.22	3.21	4.49	19.92	—	15.43	15.00
ACID PHOSPHATE											
Am. Agri. Chem. Co., Boston, Mass.											
Plain Superphosphate	Fitchburg	11.48	821	9.57	8.29	4.26	1.53	14.08	13.00	12.55	12.00
Plain Superphosphate	Amherst		64								
" "	Fall River		333								
" "	S. Amherst	12.85	736	8.30	10.43	3.91	.79	15.13	15.00	14.34	14.00
" "	Worcester		831								
" "	W. Upton		924								
" "	Southbridge		1015								
Berkshire Fert. Co., Bridgeport, Ct.											
Acid Phosphate	Bradstreet	15.11	75	11.80	13.58	3.04	1.15	17.77	—	16.62	16.00
Bowker Fert. Co., Boston, Mass.											
Bowker's Acid Phosphate	Boston		575								
" " "	Northa'pton		793								
" " "	Springfield	13.10	856	9.05	10.84	3.73	.89	15.46	15.00	14.57	14.00
" " "	Ayer		934								
" " "	Charlton		998								
Coe-Mortimer Co., N. Y. City.											
E. Frank Coe's H. G. Sol. Phos.	Westford	13.12	1228	9.89	9.89	4.32	1.91	16.12	15.00	14.21	14.00
Acid Phosphate	Amherst	13.41	1256	8.06	11.65	3.52	.26	15.43	—	15.17	—
Int. Agric. Corp., Buffalo, N. Y.											
Acid Phosphate	Easthampton	14.62	412	14.67	12.22	4.18	.69	17.09	17.00	16.40	16.00
Acid Phosphate	Hockanum	14.99	621	12.47	14.20	2.54	.46	17.20	17.00	16.74	16.00
Dissolved Phosphate	Hockanum	13.88	628	11.40	12.37	3.14	.61	16.12	15.00	15.51	14.00
" "	N. Amherst		737								
Lowell Fert. Co., Boston, Mass.											
Acid Phosphate	N. Amherst	14.73	419	9.89	13.49	2.89	.71	17.09	15.00	16.38	14.00
" "	N. Hadley		495								
Nat. Fert. Co., Boston, Mass.											
Plain Superphosphate	Marlboro	12.69	1071	8.73	9.60	4.89	.36	14.85	15.00	14.49	14.00
Nitrate Agencies Co. N. Y. City.											
Acid Phosphate	Seekonk	13.85	363	10.83	12.76	2.85	.23	15.84	15.00	15.61	14.00
Acid Phosphate	Heath	14.97	1295	8.87	14.50	2.38	.05	16.93	15.00	16.88	14.00
Acid Phosphate	Bridgewater	13.17	720	11.76	6.89	8.06	1.30	16.25	15.00	14.95	14.00
Acid Phosphate	Framingham		982								
" "	N. Amherst	15.59	1062	10.35	14.70	2.67	.56	17.93	—	17.37	16.00
" "	Southwick		1121								
Acid Phosphate	Feeding Hills	16.37	1279	5.64	15.60	2.70	.43	18.73	—	18.30	—

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Retail Cash Cost at Market Centers.	Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Availab[le] Found.	
ACID PHOSPHATE (Concluded)											
Sanderson Fert. and Chem. Co., New Haven, Ct.											
Plain Superphosphate	Gt. Barrington	$13 97	1197	13.01	12.88	2.58	.79	16.25	—	15.46	14
Whitman & Pratt Rend. Co., Lowell, Mass.											
Acid Phosphate	N.Chelmsford	15 66	944	11.03	14.90	2 42	.77	18.09	16.00	17.32	14
Wilcox Fertilizer Works, Mystic, Ct.											
Wilcox Acid Phosphate " " "	New Bedford Dighton	15.06	267 319	12.34	13.88	2.75	.92	17.55	16.00	16.63	15
BASIC SLAG PHOSPHATE											
American Agric. Chem. Co., Boston, Mass.											
Thomas Phosphate Powder (Basic Slag) " " " " "	Leominster Conway	14.13	914 1173	.11	—	16 68	1.97	18.65	17 00	16.68	
E. E. Bisbee, Boston, Mass.											
Basic Slag Meal	Manf. Sample	12.87	1238	.25	—	14.78	2.62	17.40	17.00	14.78	13
Bowker Fertilizer Co., Boston, Mass.											
Thomas Phosphate Powder (Basic Slag) " " " " "	Boston Charlton	13.31	557 996	.13	—	15.55	2.18	17.73	15.00	15.55	5
Coe-Mortimer Co., New York City.											
Thomas Phosphate Powder " " " " " " " " " " " "	N. Amherst Concord N. Hadley Lynn S. Amherst	13 37	153 424 497 602 739	.16	—	15.84	1.76	17.60	17 00	15.84	15
Thomas Phosphate Powder	Seekonk	13 40	362	.19	—	15.82	1.86	17.68	17.00	15.82	15
Thomas Phosphate Powder	Amherst	13 94	1251	.07	—	16.20	2 45	18.65	17.00	16.20	15
Thomas Phosphate Powder	Amherst	14 12	1287	.21	—	16.02	3 30	19 32	17.00	16.02	15
Nitrate Agencies Co., New York City.											
Basic Slag " " " "	Sunderland Bridgewater Southbridge	12.74	78 714 1140	.22	—	14.59	2 68	17.27	17.00	14.59	15
Basic Slag	Amherst	5.70	1288	.10	—	17.88	3.54	21.42	—	17.88	
Ross Bros'. Co., Worcester, Mass.											
Basic Slag Phosphate " " "	Worcester Fitchburg	13.42	827 829	.24	—	15 95	1.65	17.60	—	15.95	14
Basic Slag Phosphate	Lyonsville	12 69	1247	.06	—	14 04	3.65	17.69	—	14.04	14
Sanderson Fertilizer & Chem. Co., New Haven, Ct.											
Thomas Phosphate Powder	Sunderland	12.13	174	.30	—	14.14	2.06	16.20	17.00	14.14	15
Whitman & Pratt Rend. Co., Lowell, Mass.											
Basic Slag	N. Chelmsford	10.00	954	.32	—	12.12	.76	12.88	17.00	12.12	13
Wilcox Fertilizer Works, Mystic, Ct.											
Wilcox Basic Slag " " "	New Bedford Westfield	12.57	239 999	.27	—	15.17	1.08	16.25	16.00	15.17	14

LIME COMPOUNDS.

Name of Manufacturer and Brand.	Where Sampled.	Moisture.	Calcium Oxide (CaO). Found.	Calcium Oxide (CaO). Guaranteed.	Magnesium Oxide (MgO.) Found.	Magnesium Oxide (MgO.) Guaranteed.	Carbonic Acid (CO_2).	Insoluble Matter.
AGRICULTURE LIME								
kshire Hills Co., Suffield, Mass.								
erkshire Hills Co. Agricultural Lime	Manf. Sample	.73	56.64	40.89	9.12	6.33	4.35	8.32
shire Lime Mfg. Co., Cheshire, Mass.								
heshire Agricultural Lime	Amherst	.33	59.76	58-70	1.44	.60	30.40	.86
" " "	N. Amherst							
" " "	Amherst							
s. A. Creighton, Thomaston, Maine.								
igh Calcium Lime	Leominster	none	66.44	——	10.62	——	7.70	2.80
" " "	Marlboro							
iam Cheshire Lime Co., Farnams, Mass.								
›ecially Prepared Agricultural Lime	Manf. Sample	none	62.60	60-75	.48	0-1.50	30.05	.48
en Mountain Lime Co., Middlebury, Vt.								
reen Mountain Agricultural Lime	Manf. Sample	none	66.40	60-95	1.50	Trace	3.45	4.90
sac Valley Lime and Marble Co., Adams, Mass.								
dams Agricultural Lime	Hadley	5.80	59.78	52.6-72.64	.81	.44-1.14	12.10	3.27
dams Agricultural Lime	N. Amherst	4.44	58.78	52.60	.49	.44	19.75	3.13
" " "	Fitchburg							
England Lime Co., Danbury, Ct.								
dams (Mass.) Fresh Burned Granulated Lime	Manf. Sample	none	81.72	80-100	.73	0-3.00	5.03	1.83
dams (Mass.) Agricultural Lime	Manf. Sample	.60	63.64	50-75	1.84	0-4.00	15.25	2.86
onn. Agricultural Lime	Manf. Sample	.25	42.70	40.65	29.76	15-45	5.85	1.67
s and Whipple, Hartford, Ct.								
. & W. Agricultural Lime	S. Deerfield	none	65.24	60-75	.48	0-1.50	22.70	1.03
kland-Rockport Lime Co., 45 Milk St, Boston.								
-R Land Lime	Sunderland	.07	63.16	55.00	1.02	.50	16.78	1.11
" " "	New Bedford							
" " "	Hadley							
" " "	Plymouth							
" " "	Sunderland							
" " "	Boston							
urity Cement & Lime Co., Martinsburg, W. Va.								
erkeley Hydrated Lime	Middleboro	1.46	67.10	70.00	2.39	——	4.20	.62
Stearns Lime Co., Danbury, Ct.								
gricultural Lime	W. Millbury	none	73.86	——	8.01	——	.46	——
Tobey Lime Co., West Stockbridge, Mass.								
obey Brand Agricultural Lime	W. St'kb'dge	—	65.00	——	2.88	——	5.73	2.29
ton Quarries, Harrisburg, Pa.								
atent Process Lime Fertilizer	Springfield	.21	60.48	——	3.94	——	9.64	5.15
rles Warner Co., 161 Devonshire St, Boston, Mass								
imoid (Hydrated Lime)	Marblehead	.15	47.98	47.00	32.30	31.50	.68	.51
st Stockbridge Lime Co., West Stockbridge, Mass.								
gricultural Lime	Billerica	.61	61.58	50-65	5.84	4-6	8.78	2.72

NOTE—Page 94 Completes this table.

Lime Compounds.

Laboratory Number.	Cost of 100 lbs. of Calcium and Magnesium Oxides.	Probable Composition of Lime Products as based upon foregoing Analyses.						Calcium Sulfate Gypsum (Ca SO_4).	
		Free Calcium Oxide (CaO).	Free Magnesium Oxide (MgO).	Hydrated or Slaked Lime (Calcium Hydrate $Ca(OH)_2$).	Calcium Carbonate ($CaCO_3$).	Magnesium Carbonate ($MgCO_3$).	Guaranteed Calcium and Magnesium Carbonates Combined.	Found.	Guaranteed.
A 41	$ .51	——	*	67.51	9.90	——	32.45	——	——
A 6 A 9 A 29	53	——	1 44	27.76	69 15	——	25 00	——	——
†A 38 †A 39	59	17 92	10 62	51 14	17 52	——	——	——	——
A 46	54	4 40	.48	26.27	68 36	——	50 00	——	——
A 2	——	——	1 50	81.93	7.85	——	5-10	——	——
A 1 A 11 A 33	44 45	—— ——	.81 .49	58.60 44.40	27.53 44 93	—— ——	28.00 28.00	—— ——	—— ——
A 42 A 44 A 43	61 59 .50	42 05 —— ——	.73 1 84 10 87*	43 95 58 41 46 57	11.44 34 69 13 31	—— —— ——	0-20 15-40 10-40	—— —— ——	—— —— ——
A 34	61	3 48	.48	43 37	51 64	——	50.00	——	——
A 7 A 8 A 14 A 19 A 21 A 23	60	——	1 02	55.19	38 17	——	30.00	——	——
†A 31	——	——	*	81.60	9 55	——	——	——	——
†A 53	.35	18 29	——	72.65	1.05	——	——	——	——
A 55	30	——	2.88	76.24	13.03	——	——	——	——
†A 52	——	——	3.94	64.06	21 95	——	——	——	——
†A 25	.61	——	25.07*	82.25	1 55	——	.05	——	——
†A 26	.63	——	*	66.59	19.97	——	25.00	——	——

* No. A 41 There is probably 13.19% magnesium hydrate present in this sample.
No. A 43 " " " 27.33% " " " " " "
No. A 31 " " " 3.16% " " " " " "
No. A 25 " " " 10.47% " " " " " "
† Not registered, bought for own use.
* No. A 26 There is probably 8.45% magnesium hydrate present in this sample

Lime Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Moisture.	Calcium Oxide (CaO). Found.	Calcium Oxide (CaO). Guaranteed.	Magnesium Oxide (MgO.) Found.	Magnesium Oxide (MgO.) Guaranteed.	Carbonic Acid (CO2).	Insoluble Matter.
			Chemical Analysis of Lime Products.					
AGRICULTURAL LIME (Concluded)								
t Stockbridge Lime Co., West Stockbridge, Mass.								
ıdoor Agricultural Lime	Amherst	.81	59.29	—	5.56	—	15.00	2.42
ıdoor Agricultural Lime	Amherst	.67	59.72	—	6.97	—	13.38	2.22
utdoor Agricultural Lime	W. Stockb'dg'e	—	55.96	50.65	4.16	4.6	14.28	6.38
GROUND LIME STONE								
. Conley Stone Co, Utica, N. Y.								
aw Ground Lime " " "	S. Deerfield Deerfield	.06	52.28	51.50	1.15	—	—	4.17
aw Ground Lime	Palmer	.06	52.33	51.50	1.14	—	—	3.80
on Portland Cement Co., Stewartsville, N. J.								
dison Pulverized Limestone " " "	Brockton Framingham	.06	48.08	50.00	1.56	—	—	9.93
ıgers Lime and Marble Co., Danbury, Ct.								
me stone	Manf. Sample	none	55.17	—	.43	—	—	1.13
Stearns Lime Co., Danbury, Ct.								
round Limestone " " " "	Fall River Whately Whately	.14	46.50	48.75	3.00	—	—	11.47
MARL								
l Products Co., Barton, Vt.								
gricultural Marl	Manf. Sample	1.38	49.64	51.83	.26	0-.22	—	1.72
nont Marl Co., Brattleboro, Vt.								
ıell-Marl Land-Lime	Hadley	5.81	48.36	50.00	.49	—	—	2.17
LIME ASHES								
. Felton, High Gate Springs, Vt.								
me Ashes	Hadley	20.98	41.44	—	3.10	—	—	4.09
sac Valley Lime and Marble Co., Adams, Mass.								
dams Lime Ashes	Manf. Sample.	4.25	45.72	30.90	.77	1-1.20	—	11.11
.. Mitchell, New Haven, Ct.								
me Kiln Ashes	Manf. Sample.	2.60	50.54	30.45	.65	50-1.50	—	6.35
England Lime Co., Danbury, Ct.								
dams (Mass.) Lime Ashes	Manf. Sample	19.13	39.51	20.00	1.91	0-5.00	—	—
dams Lime Ashes	Manf. Sample	.63	48.72	—	—	—	—	7.94
ınaan (Conn.) Lime Ashes	Manf. Sample	8.60	38.93	20.00	16.06	10-20	—	2.05
t Stockbridge Lime Co., West Stockbridge, Mass.								
me Ashes	Agawam	12.38	35.02	—	2.28	—		20.24
GYPSUM (Sulphate of Lime or Plaster.)								
rican Agric. Chem. Co., Boston, Mass.								
ne Ground Nova Scotia Land Plaster " " " " " " " " " " " " " " " " " "	Amherst Plymouth Boston Fitchburg	3.30	38.78	30.89	.69	—	—	1.12
ker Fertilizer Co., Boston, Mass.								
ova Scotia Land Plaster	Fall River	5.87	37.85	24.71	.35	—	—	1.52
ova Scotia Land Plaster	Concord	5.36	37.96	30.89	.55	—	—	1.34
ova Scotia Land Plaster	Wrentham	3.89	38.50	24.71	.36	—	—	1.56
r's Agric. Chem. Works, Newark, New Jersey.								
round Nova Scotia Land Plaster	Fall River	3.75	37.94	30.89	1.09	—	—	1.87

NOTE—Page 96 Completes this Table.

Lime Compounds.

Laboratory Number.	Cost of 100 lbs. of Calcium and Magnesium Oxides.	Probable Composition of Lime Products as based upon foregoing Analyses. Free Calcium Oxide (CaO).	Free Magnesium Oxide (MgO).	Hydrated or Slaked Lime (Calcium Hydrate $Ca(OH)_2$).	Calcium Carbonate ($CaCO_3$).	Magnesium Carbonate ($Mg CO_3$).	Guaranteed Calcium and Magnesium Carbonates Combined.	Calcium Sulfate Gypsum ($Ca SO_4$) Found.	Guaranteed.
A 50	$ .55	—	5.56	53.08	34.12	—	—	—	—
A 51	.52	—	6.97	56.37	30.44	—	—	—	—
A 56	.51	—	4.16	49.90	32.48	—	—	—	—
A 16, A 17	.70	—	—	—	93.29	2.40	95.00	—	—
A 57	.65	—	—	—	93.38	2.38	95.00	—	—
A 20, A 35	.75	—	—	—	85.80	3.26	93.00	—	—
†A 4	.40	—	—	—	98.45	.90	—	—	—
A 10, A 27, A 30	.68	—	—	—	82.98	6.27	87.00	—	—
A 45	—	—	—	—	88.59	.54	92.00	—	—
A 32	.67	—	—	—	86.30	1.02	89.23	—	—
†A 58	.81	—	—	—	73.95	6.48*	—	—	—
A 40	.47	—	—	—	81.59	1.61*	—	—	—
A 47	.59	—	—	—	90.19	1.36*	—	—	—
A 48	.94	—	—	—	70.51	3.99*	—	—	—
A 3	.79	—	—	—	86.94		—	—	—
A 49	.65	—	—	—	69.47	33.59*	—	—	—
†A 54	—	—	—	—	62.49	4.77*	—	—	—
A 5, A 18, A 24, A 37	—	—	—	—	—	1.44	—	94.14	75.00
A 12	—	—	—	—	—	.73	—	91.88	60.00
A 28	—	—	—	—	—	1.15	—	92.15	60.00
A 38	—	—	—	—	—	.75	—	93.46	60.00
A 15	—	—	—	—	—	2.28	—	92.10	75.00

† Not registered, bought for own use.

* No. A 54 Phosphoric Acid .45% potassium oxide .86%.
" A 58 " " .56% potassium oxide 2.31%
" A 40 " " trace " " none
" A 47 " " trace " " .04%
" A 3 " " .52% " " .75%
" A 49 " " 1.20% " " 2.05%

BULLETIN No. 148 APRIL, 1914

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

ON THE DIAGNOSIS OF INFECTION WITH BACTERIUM PULLORUM IN THE DOMESTIC FOWL

By GEO. EDWARD GAGE

WITH THE ASSISTANCE OF

BERYL H. PAIGE and HAROLD W. HYLAND

This bulletin presents results of experiments to determine whether diagnosis of Bacterium pullorum by testing the eggs of suspected hens is a practicable method of diagnosis. The conclusion is that, owing to the fact that the elimination from the ovary is so irregular, it would be impossible to make a diagnosis within a short period of time. It presents also the results of a study of the macroscopic agglutination test as suggested by F. S. Jones. This proved to be a good laboratory method for the detection of adult hens harboring or which have harbored Bacterium pullorum.

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Amherst, Mass.

Massachusetts Agricultural Experiment Station.

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VETERINARY DEPARTMENT.

ON THE DIAGNOSIS OF INFECTION WITH BACTERIUM PULLORUM IN THE DOMESTIC FOWL.

By GEO. EDWARD GAGE

WITH THE ASSISTANCE OF

BERYL H. PAIGE AND HAROLD W. HYLAND

(From the Department of Veterinary Science)

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

During the last two years the scientific evidence at hand concerning the rôle of *Bacterium pullorum* (Rettger) in bacillary white diarrhœa of young chicks and relations of it to ovarian infection in adult fowls has been most conclusive. Rettger and Stoneburn[1] pointed out the fact that adult hens were the original source of infection to young chicks suffering with bacillary white diarrhœa.

In their report of 1911[2] they further substantiate the results of the previous paper in that adult hens are the original source of infection; that eggs from infected hens may contain the organism in the yolk.

In a third report, 1912,[3] they fully support statements of their previous work concerning ovarian infection, and they conclude that the ovaries may become infected by contact of the hens with infected hens or by artificial infection of the litter. "The infection is, in all probability, acquired through the mouth."

Gage, in 1910–11,[4] in publication of reports from experiments conducted at the Maryland Experiment Station, concluded that Rettger and Stoneburn were correct in their work of the previous year, corroborating the fact that white diarrhœa, as poultrymen understand it, is a bacillary disease caused by *Bacterium pullorum* (R), and that the hen is the original

[1] Rettger, L. F., and Stoneburn, F. H.: Bulletin No. 60, 1909, Storrs Agricultural Experiment Station. "Bacillary white diarrhœa of young chicks."

[2] Rettger, L. F., and Stoneburn, F. H., Bulletin No. 68, 1911, Storrs Agricultural Experiment Station. "Bacillary white diarrhœa of young chicks" (second report).

[3] Rettger, L. F., Stoneburn, F. H., and Kirkpatrick, Wm. F.: Bulletin No. 74, 1912. "Bacillary white diarrhœa of young chicks" (third report).

[4] Gage, Geo. Edward: "Notes on ovarian infection with *Bacterium pullorum* (Rettger) in the domestic fowl." Journal Medical Research, Vol. XXIV., No. 3; N. S., Vol. XIX., No. 3; June, 1911, pp. 491–496.

source of infection, transmitting the organism from the ovary to the eggs.

Jones, in his reports of 1910 [1] and 1911,[2] again supports the work of Rettger and Stoneburn, and also finds that the local disease in the ovary of adult fowls may be produced by the intravenous injections of *Bacterium pullorum.*

From these reports it can be seen that the problem now consists in methods of determining the presence of the virus in adult hens. From examination of eggs it has been almost impossible to make a diagnosis of this infection within a short time, since *Bacterium pullorum* is eliminated so irregularly that it is necessary, often, to examine all eggs laid by a suspected hen over a long period.

Jones [3] suggested the use of an agglutination similar to that used in the diagnosis of glanders and contagious abortion for detecting ovarian infection, and in a later paper [4] has given an excellent example of the value of the macroscopic agglutination test for detecting individuals harboring *B. pullorum.*

It is the object of this paper to present the results of the work conducted in the investigational laboratory of the department of veterinary science concerning the diagnosis of this ovarian infection in adult hens by egg analysis and by macroscopic agglutination tests, together with data which have been obtained concerning the various factors which must be considered in making the tests. It shall also serve to demonstrate the practicability of these tests as a routine laboratory procedure, the work having been performed in many respects by three different technicians.

The subjects used for these experiments were all suspected of harboring the virus of *Bacterium pullorum.* The organism had been detected in the yolk of eggs from hens Nos. 267, 792, 452, 714 and 464 prior to their arrival at the laboratory. Hens Nos. 1, 2, 4, 5, 6, 7, 8, 10, 13, 18, 22, 34, 35, 46, 48, 49, 52, 53, 60, 61, 77, 312, 315, 618 and 2096 were all suspects. Hens Nos. 1, 2, 4, 5, 6, 7, 8, 10, 13, 18, 22, 48, 52 and 53 had been inoculated intravenously with 1 c.c. of a bouillon suspension of a culture of *Bacterium pullorum*[5] known according to the filing-denotation of *Bacterium pullorum* in this laboratory as M., which had been isolated from the ovaries of a white Orpington pullet, and proven absolutely to be capable of producing the disease in young chicks. Hens Nos. 34, 35, 46, 49, 60, 61, 77, 312, 315, 618 and 2096 had been closely associated with hens which had received the intravenous injection, but, so far as the author has been able to ascertain, only for a short time. Since the data on these last

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[1] Jones, F. S.: "Fatal septecemia or bacillary white diarrhœa in young chickens." Annual Report of the New York State Veterinary College for 1910, pp. 111–129.

[2] Jones, F. S.: "Further studies on bacillary white diarrhœa in young chickens." Report, New York State Veterinary College, 1910–11, pp. 69–88.

[3] Jones, F. S.: Report, New York State Veterinary College for 1910–11, p. 76.

[4] Jones, F. S.: "The value of the macroscopic agglutination test in detecting fowls that are harboring *Bact. pullorum.*" Journal Medical Research, Vol. XXVII., No. 4; N. S., Vol. XXII., No. 4, pp. 485–495.

[5] Gage: "Notes on ovarian infection with *Bacterium pullorum* in the domestic fowl." Journal Medical Research, Vol. XXIV., No. 5; N. S., Vol. XIX., No. 3, p. 493.

birds were so incomplete concerning their histories, it was considered wise to put all together and include them all in the tests. Birds Nos. 1, 2, 4, 5, 6, 7, 8, 10, 13, 18, 22, 48, 52 and 53 were all more than three years old, and were sent to this laboratory through the kindness of Director H. J. Patterson of the Maryland Agricultural Experiment Station, where the author had started work to determine the possibility of artificial infection of ovarian tissue by intravenous injections of the organisms, — work which was interrupted before final results could be obtained.[1] Jones,[2] however, was successful in his attempts to bring about ovarian infection with *Bact. pullorum* by the injection of pure cultures of the organism into the blood circulation of hens.

All individuals retained for these tests were trap-nested and complete egg records kept of each hen.

Methods employed in the Examination of Eggs for Bacterium Pullorum.

The object primarily in making the examination of all eggs laid by these suspected hens was to determine if possible the presence of the organism in the yolk, which would be of value in checking up the work in connection with any of the serum reactions which later might prove positive. The method used for these egg analyses was essentially that used by Rettger.[3] Eggs were allowed to remain several minutes in carbolic acid (1–40) and dried with sterile absorbent cotton. The end of the egg was sterilized by flaming, the flamed portion cut around with sterile scissors. The albumin was carefully separated from the yolk and the yolk inserted into a large test tube (Buchner type) containing about 30 c.c. sterile bouillon. In the first part of the egg-testing work fresh eggs were studied, but later the eggs were incubated prior to the testing, and in some instances sufficiently long for embryos to develop. In such cases a sterile platinum loop or scissors were used to aid in freeing the embryo from the shell and albumin. If embryo was very large it was inserted into sterile bouillon along with the rest of the yolk. The disintegrated egg yolks in bouillon were placed in the incubator at 38° C. and allowed to remain there for varying lengths of time, the shortest period being twenty-four hours and the longest two hundred and eighty hours. After tubes were taken from bacteriological incubator the material was thoroughly mixed and four samples streaked on four different tubes of agar. These were placed in the bacteriological incubator and examined macroscopically for the presence of the typical *Bact. pullorum* colonies at the end of twenty-four, forty-eight and seventy-two hours. A tube was not considered negative until it had been allowed to incubate for

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[1] Work referred to by Dr. Rettger in Bulletin No. 74, Storrs Agricultural Experiment Station, Storrs, Conn., p. 162, line 12.

[2] Jones, F. S., "Further studies on bacillary white diarrhœa in young chickens." Report, New York State Veterinary College, 1910-11, pp. 69-88.

[3] Rettger, L. F., and Stoneburn, F. H., Bulletin No. 68, 1911, Storrs Agricultural Experiment Station, "Bacillary white diarrhœa of young chicks" (second report).

seventy-two hours. In many cases when there was doubt concerning organism, all materials were plated out and colony again streaked from such plates.

In view of the fact that many inquiries had been received here at this laboratory concerning the egg test for the determination of this organism, it was decided worth while to test all eggs laid by these suspected hens, and also to record what effect the retention of egg prior to testing, and length of time egg material remained in the bacteriological incubator at 38° to 39° C., had in facilitating isolation of the organism.

In tables 1, 2 and 3 are exhibited the data obtained from the egg tests tabulated to show when egg was laid, by which hen laid, and whether the organism was isolated from the hen, a fact designated by a plus sign. It also shows to how long a period of incubation the egg material in bouillon was submitted before being streaked on the agar slants.

During the period of making the first egg tests all eggs were retained at room temperature until tested, or they were tested on the same day, soon after laying. Later, however, it was found advisable to retain at the temperature of the bacteriological incubator, about 39° C., before inserting in sterile bouillon, to afford perhaps a preliminary proliferation of the organism.

TABLE 1.

Egg Record of Hens 267-61 showing date of egg laid and egg in which Bacterium pullorum was detected. July

Hen No. / Date →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
267								X -		X -	X -	X -		X -	X -	X -		X -										X -	X -	X -	X -
8								X -		X -	X -		X -	X -		X -		X -			X -		X -		X -			X -		X -	X -
315								X -		X -	X -			X -		X -	X -									X -	X -		X -	X -	
1								X -				X -		X -	X -		X -														X -
49									X -	X -		X -	X -		X -	X -		X -	X -								X -	X -		X -	X -
60									X -		X -	X -		X -	X -	X -		X -	X -		X -				X -	X -		X -	X -	X -	
22									X -			X -								X -											
10										X -	X -		X -	X -		X -	X -				X -					X -	X -		X -	X +	
18										X -		X -	X -		X -		X -		X -		X -			X -		X +		X -		X -	X -
77										X -	X -		X -	X -	X -	X -	X -		X -	X -		X -		X -		X -	X -	X -		X -	X -
6										X -		X -	X -		X -	X +	X +		X +												
206										X -			X -		X -	X -	X -	X -	X -		X -		X -		X -	X -	X -	X -		X -	X -
5										X -	X -		X -	X -		X -	X -		X -				X -		X -		X -		X -	X +	
2										X -		X -	X -		X -	X -		X -								X +	X -		X -	X +	
4										X -	X -		X -		X -	X -		X -	X -		X -				X -						
35										X -		X -	X -		X -	X -		X -	X -		X -	X -	X -		X -	X -	X -		X -		
48										X -		X -	X -		X -		X -		X -											X -	X -
618										X -		X -	X -		X -	X -		X -			X -				X -	X -		X -	X -		X -
7											X -			X -		X -	X -		X -								X -		X -	X -	
312											X -		X -																		
46											X -		X -		X -	X -		X -		X -						X -	X -		X -		X -
52											X -		X -	X -	X -		X -	X -		X -	X +		X +	X -	X -				X -		
13											X -	X		X -	X -		X -		X -	X -		X +				X +		X -	X -		X -
53													X -					X -	X -		X -		X -		X -		X -		X -		X -
452												X -	X -		X -	X -															
792															X -	X -		X -		X -			X +		X +		X -			X +	
714															X		X			X							X +		X	X	
34														X -										X -	X -		X -	X -		X -	
464														X -			X -	X	X -		X -					X -		X -		X -	
61																									X -		X -	X -			X -

X = egg laid
- = B. pullorum not detected
+ = B. pullorum detected.

TABLE 2.

Egg Record of Hens 267–61 showing date of egg laid and egg in which Bacterium pullorum was detected. August

Hen No. / Date →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
267	x –	x –		x –	x –		x –						x –		x –	x –	x –		x –		x –	x –	x –	x –			x –				
8		x –		x –		x –		x –				x –		x –		x –		x +							x –			x –		x –	
315	x –	x –		x –	x –		x –	x –				x –		x –		x –	x –		x –	x –		x –		x –		x –		x –		x –	x –
1	x –		x –	x –				x –		x –		x –			x +																
49	x –		x –	x –		x –	x –		x –	x –		x –	x –		x –	x –	x –		x –	x –		x –		x –	x –		x –				x
60	x –		x –													x –	x –		x –	x –		x –									
22													x –	x –		x –	x –		x –	x –		x –				x –					
10	x –	x –		x –		x –				x –		x +		x –	x +		x –														
18						x –					x –		x –			x –	x –				x –		x –		x –						
77	x –	x –		x –	x –	x –	x –	x –	x –		x –	x –	x –	x –		x –	x –	x –	x –		x –		x –	x –			x –			x –	
6			x –								DIED																				
296		x –	x –		x –		x –				x –	x +	x –	x –		x –	x –	x –	x –		x –	x –	x –		x –						
5	x –	x +		x +	x –		x –	x –	DIED																						
2	x –	x –																													
4							x –		x –		x –	x –		x –	x –		x –			x –				x –				x –			x –
35	x –		x –		x –	x –				x –	x –	x –		x –	x –		x –				x –				x –						x –
48		x –	x –		x –			x –			x –								x –		x –		x –		x –						
618	x –	x –		x –	x –		x –	x –	x –		x –	x –		x –	x –	x –		x –	x –	x –		x –		x –							
7	x –		x –	x +		x –		x –			x –		x +		x –		x –		x –		x –										
46	x –			x –		x –	x –	x –		x –	x –	x –		x –	x –																
13		x –	x –		x –	x –		x –	x –				x –		x –	x –		x –		x –					x +						
53	x –				x –	x –			x –	x –		x –	x –		x –	x –		x –		x –											
792	x –	x –			x –	–			x –		x –	x +		x –	x –		x –	x –		x –	x –		x –	x –		x –		x –		x –	
714	x –	x –		x –		x –	x –		x –		x –		x +		x –		x –									x –		x –		x –	
34	x –		x –		x –								x –	x –		x –	x –	x –		x –		x –		x –							
464						x –					x –																				
61	x –	x –		x –	x –				x –		x –	x –		x –	x –	x –		x –										x –		x –	x –

x = egg laid
– = B. pullorum not detected
+ = B. pullorum detected

TABLE 3.

Egg Record of Hens 267-61 showing date of egg laid and egg in which Bacterium pullorum was detected September

HEN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
267																			X –	X –	X –				X –		X –				
8																															
315		X –		X –		X –				X –		X –		X –			X –			X –	X –										
1																															
49		X –		X –	X –																										
60	X –		X –	X –																		X –			X –						
22																															
10																															
18																															
77																															
6																															
2096									X –	X –		X –						X –		X –											
5																															
2																															
4				X –	X –				X –	X –		X –				X –					X –		X –								
35		X –																													
48				X –		X +																									
618																															
7																															
312																															
46																															
52																															
13																															
53																									X –						
452																															
792	X –																														
714	X –																				X +										
34								X –																							
464											X –		X +			X +															
61																		X –													

X = egg laid
– = B pullorum not detected
+ = B pullorum detected

From Table 4, it can be seen that of the 619 eggs tested *Bacterium pullorum* was detected in eggs laid by hen No. 10, once during July, egg laid 7–30–13; by hen No. 18, once during July, egg laid 7–26–13; by hen No. 6, three times during the month, eggs laid 7–16–13, 7–17–13 and 7–19–13; by hen No. 5, once during month, egg laid 7–30–13; by hen No. 2, twice during month, eggs laid 7–26–13 and 7–30–13; by hen No. 52, twice during month, eggs laid 7–21–13 and 7–23–13; by hen No. 13, twice, eggs laid 7–22–13 and 7–26–13; by hen No. 792, three times, eggs laid 7–23–13, 7–25–13 and 7–30–13; by hen No. 714, once during month, egg laid 7–27–13. During August from hen No. 8 *Bact. pullorum* was isolated from one egg laid 8–18–13; by hen No. 1, once during month, egg laid 8–15–13; by hen No. 10, twice, eggs laid 8–12–13 and 8–15–13; by hen No. 2096, once during month, egg laid 8–12–13; by hen No. 5, twice, eggs laid 8–2–13 and 8–4–13; by hen No. 7, twice, eggs laid 8–4–13 and 8–13–13; by hen No. 13, once, egg laid 8–25–13; by hen No. 792, once, egg laid 8–12–13; by hen No. 714, once, egg laid 8–13–13. During September the organism was isolated from egg of hen No. 48, once, egg laid 9–6–13; by hen No. 714, once, egg laid 9–21–13; by hen No. 464, twice, eggs laid 9–13–13 and 9–16–13.

Of the 16 cultures of *Bacterium pullorum* isolated from eggs in July the yolk material of 13 in sterile bouillon had been retained in bacteriological incubator for more than seventy-two hours. Of the 12 isolated in August, all yolk material in bouillon had been retained in bacteriological incubator more than seventy-two hours. From the 4 isolated in September, the egg material had been in incubator but forty-eight hours. After August 1 it was planned to put all eggs in bacteriological incubator prior to testing, and this brought forth egg material which yielded cultures of *Bacterium pullorum* which had not been detected in July, namely, the infection was detected in hen No. 8, hen No. 1, hen No. 2096 and hen No. 7. By the previous incubation of eggs, for one to three days, the organism had multiplied to such an extent that it was possible to detect the organisms in 7 individuals in whom it had not been detected in July. From egg material incubated in bacteriological incubator at 38° to 39° C. for seventy-two hours or longer it was much easier to detect the organism. Usually it was present in large numbers, and the organism on the agar-slant usually became visible within the first twenty-four hours' incubation. In general it may be stated that egg testing of these hens' eggs yielded better results after this preliminary incubation of the eggs in bacteriological incubator, and it was found always advisable to wait seventy-two hours before considering a sample negative as regards colonies on subsequent agar streaks.

From what has been determined here, and from the work of Rettger and Jones, it can be clearly seen that diagnosis by egg testing is impractical. In some cases, however, the egg testing has given results with the examination of the first few eggs. According to the work in this laboratory, it has been found that if a bird is badly infected persistence in egg testing will usually yield a positive result. Of the 619 eggs tested from hens in

Table 4.

TABLE SHOWING WHEN EGG WAS LAID, HEN NUMBER, NUMBER OF HOURS MATERIAL WAS RETAINED IN BACTERIOLOGICAL INCUBATOR

+ = ORGANISM FOUND
− = ORGANISM NOT FOUND

JULY	24 HRS	43 HRS	48HRS	65HRS	72HRS	88HRS	90HRS
	6 7/16 +	22 7/20 -	267 7/8 -	267 7/12 -	267 7/10 -	267 7/18 -	267 7/16 -
	35 7/2 -		267 7/11 -	8 7/13 -	8 7/8 -	8 7/8 -	267 7/29 -
			267 7/14 -	8 7/14 -	8 7/10 -	315 7/7 -	315 7/16 -
			267 7/15 -	1 7/8 -	315 7/10 -	1 7/7 -	315 7/29 -
			8 7/11 -	1 7/12 -	315 7/11 -	49 7/8 -	18 7/15 -
			8 7/16 -	60 7/12 -	49 7/9 -	60 7/8 -	5 7/16 -
			8 7/30 -	22 7/12 -	49 7/14 -	10 7/7 -	35 7/16 -
			315 7/8 -	18 7/12 -	60 7/9 -	18 7/7 -	618 7/16 -
			315 7/14 -	77 7/13 -	22 7/9 -	77 7/7 -	7 7/16 -
			1 7/14 -	77 7/15 -	10 7/10 -	77 7/9 -	46 7/16 -
			1 7/15 -	6 7/12 -	10 7/11 -	6 7/7 +	13 7/15 -
			49 7/13 -	2096 7/13 -	18 7/10 -	6 7/9 +	452 7/16 -
			49 7/15 -	5 7/13 -	18 7/19 -	2096 7/8 -	714 7/17 -
			49 7/16 -	2 7/12 -	77 7/10 -	5 7/7 -	AUGUST
			60 7/11 -	4 7/12 -	6 7/10 -	2 7/8 -	267 8/5 -
			60 7/14 -	4 7/13 -	2096 7/10 -	4 7/8 -	267 8/7 -
			60 7/15 -	35 7/12 -	2096 7/19 -	4 7/9 -	267 8/24 -
			60 7/16 -	35 7/13 -	5 7/10 -	35 7/8 -	267 8/27 -
			10 7/13 -	35 7/15 -	5 7/9 -	35 7/9 -	8 8/6 -
			10 7/14 -	48 7/12 -	2 7/10 -	48 7/7 -	8 8/8 -
			10 7/16 -	48 7/13 -	4 7/10 -	618 7/9 -	8 8/25 -
			18 7/13 -	618 7/12 -	4 7/10 -	7 7/7 -	8 8/28 -
			77 7/14 -	7 7/14 -	35 7/10 -	46 7/8 -	8 8/30 -
			77 7/16 -	46 7/15 -	48 7/10 -	52 7/8 -	315 8/8 -
			77 7/30 -	52 7/13 -	48 7/19 -	53 7/8 -	315 8/12 -
			6 7/13 -	52 7/15 -	618 7/10 -	792 7/8 -	1 8/8 -
			6 7/15 -	13 7/12 -	53 7/13 -	464 7/7 -	1 8/10 -
			2096 7/15 -	452 7/12 -	792 7/20 -	464 7/9 -	49 8/6 -
			2096 7/16 -	792 7/15 -	AUGUST	AUGUST	49 8/7 -
			2096 7/17 -	464 7/16 -	315 8/5 -	267 8/3 -	49 8/9 -
			5 7/11 -		5 8/7 -	267 8/16 -	49 8/10 -
			5 7/14 -		4 8/11 -	267 8/7 -	49 8/12 -
			2 7/13 -		7 8/11 -	8 8/2 -	10 8/6 -
			2 7/15 -		61 8/9 -	8 8/16 -	10 8/10 -
			2 7/16 -			315 8/16 -	10 8/12 +
			4 7/15 -			1 8/2 -	18 8/11 -
			4 7/16 -			1 8/15 +	77 8/6 -
			48 7/15 -			49 8/16 -	77 8/7 -
			618 7/13 -			49 8/7 -	77 8/8 -
			618 7/15 -			60 8/16 -	77 8/9 -
			7 7/11 -			60 8/7 -	77 8/11 -
			312 7/11 -			22 8/16 -	77 8/12 -
			312 7/13 -			22 8/17 -	2096 8/5 -
			46 7/11 -			10 8/15 +	2096 8/11 -
			46 7/13 -			10 8/7 -	2096 8/12 +
			52 7/11 -			18 8/16 -	2096 8/13 -
			52 7/14 -			18 8/17 -	2096 8/6 -
			52 7/17 -			77 8/14 -	2096 8/7 -
			13 7/11 -			77 8/16 -	5 8/5 -
			13 7/14 -			618 8/18 -	5 8/8 -
			13 7/17 -			13 8/15 -	4 8/7 -
			452 7/13 -			13 8/16 -	4 8/9 -
			452 7/15 -			13 8/18 -	4 8/12 -
			792 7/16 -			53 8/5 -	4 8/5 -
			714 7/15 -			53 8/16 -	4 8/7 -
			34 7/14 -			792 8/15 -	35 8/5 -
			SEPTEMBER			34 8/16 -	35 8/6 -
			267 9/19 -			34 8/17 -	35 8/10 -
			267 9/20 -			61 8/16 -	35 8/11 -
			267 9/21 -			61 8/18 -	35 8/15 -
			267 9/25 -				48 8/5 -
			267 9/27 -				48 8/8 -
			315 9/6 -				48 8/11 -
			315 9/10 -				618 8/5 -
			315 9/12 -				618 8/8 -
			315 9/14 -				618 8/9 -
			315 9/17 -				618 8/11 -
			315 9/20 -				618 8/12 -
			315 9/21 -				7 8/6 -
			60 9/22 -				7 8/8 -
			60 9/25 -				46 8/6 -
			2096 9/9 -				46 8/8 -
			2096 9/10 -				46 8/10 -
			2096 9/12 -				46 8/11 -
			2096 9/18 -				46 8/12 -
			2096 9/20 -				46 8/15 -
			4 9/9 -				13 8/6 -
			4 9/10 -				13 8/8 -
			4 9/12 -				13 8/9 -
			4 9/16 -				13 8/13 -
			4 9/21 -				53 8/6 -
			4 9/23 -				53 8/9 -
			48 9/16 +				53 8/10 -
			53 9/25 -				53 8/12 -
			714 9/21 +				53 8/13 -
			34 9/8 -				792 8/9 -
			464 9/11 -				792 8/11 -
			464 9/13 +				792 8/12 +
			464 9/16 +				792 8/7 -
			61 9/18 -				792 8/8 -
							714 8/6 -
							714 8/9 -
							714 8/11 -
							714 8/13 +
							714 8/15 -
							714 8/17 -
							34 8/5 -
							34 8/13 -
							464 8/6 -
							464 8/11 -
							61 8/5 -
							61 8/11 -
							61 8/12 -

97HRS	110 HRS	120HRS	136HRS	140HRS	163HRS	168HRS	190HRS	210 HRS	256HRS	263 HRS	283HRS
8 7/28 -	315 7/26 -	8 7/21 -	267 7/30 -	1 8/3 -	60 7/9 -	267 7/28 -	8 7/25 -	267 7/31 -	61 7/28 -	49 8/12 -	618 7/28 -
49 7/27 -	313 7/27 -	8 7/23 -	315 7/30 -	49 8/3 -	35 7/29 -		60 7/25 -	8 7/31 -			13 7/28 -
49 7/28 -	60 7/26 -	60 7/21 -	49 7/30 -	60 8/3 -	48 7/30 -		10 7/26 -	1 7/31 -			
10 7/27 -	77 7/26 -	10 7/21 -	60 7/28 -	35 8/3 -	46 7/31 -		18 7/26 +	49 7/31 -			
18 7/28 -	77 7/27 -	18 7/21 -	60 7/29 -	7 8/3 -	53 7/19 -		2096 7/25 -	10 7/30 +			
2 7/29 -	77 7/28 -	77 7/20 -	60 7/30 -	61 8/4 -	53 7/9 -		5 7/25 -	18 7/31 -			
618 7/29 -	2096 7/26 -	77 7/22 -	10 7/29 -		AUGUST		4 7/25 -	77 7/31 -			
46 7/27 -	2096 7/27 -	77 7/24 -	18 7/30 -		267 8/1 -		35 7/25 -	2096 7/31 -			
34 7/27 -	5 7/27 -	2096 7/21 -	2096 7/28 -		8 8/2 -		618 7/25 -	5 7/29 -			
464 7/28 -	2 7/26 +	2096 7/23 -	2096 7/30 -		315 8/24 -		52 7/25 -	48 7/31 -			
AUGUST	2 7/26 -	5 7/23 -	5 7/30 +		315 8/26 -		53 7/25 -	618 7/31 -			
315 8/7 -	35 7/26 -	4 7/21 -	2 7/30 +		315 8/28 -		792 7/25 +	52 7/29 -			
2096 8/7 -	35 7/27 -	35 7/21 -	7 7/29 -		315 8/30 -		61 7/25 -	13 7/31 -			
618 8/7 -	618 7/26 -	35 7/22 -	7 7/30 -		315 8/31 -			53 7/31 -			
618 8/15 -	7 7/27 -	35 7/23 -	46 7/29 -		49 8/1 -			34 7/28 -			
618 8/16 -	46 7/26 -	618 7/21 -	792 7/30 +		49 8/24 -			61 7/31 -			
7 8/15 -	13 7/26 +	46 7/20 -	714 7/30 -		49 8/25 -			AUGUST			
7 8/17 -	53 7/27 -	52 7/21 +	34 7/30 -		49 8/27 -			267 8/2 -			
714 8/17 -	792 7/27 -	52 7/23 +	464 7/30 -		49 8/31 -			315 8/1 -			
315 9/2 -	714 7/2 +	52 7/24 -	AUGUST		22 8/26 -			315 8/2 -			
315 9/4 -	714 7/29 -	13 7/8 -	5 8/1 -		18 8/25 -			1 8/1 -			
49 9/2 -	464 7/26 -	13 7/19 -	46 8/1 -		77 8/24 -			60 8/1 -			
49 9/4 -	61 7/27 -	13 7/20 -	792 8/1 -		77 8/27 -			10 8/1 -			
49 9/5 -	AUGUST	13 7/22 +			77 8/30 -			10 8/2 -			
60 9/1 -	267 8/15 -	53 7/21 -			2096 8/25 -			77 8/1 -			
60 9/3 -	8 8/14 -	53 7/23 -			4 8/24 -			77 8/2 -			
60 9/4 -	8 8/18 +	792 7/23 +			4 8/28 -			2096 8/2 -			
4 9/4 -	315 8/14 -	714 7/20 -			4 8/31 -			5 8/2 +			
4 9/5 -	49 8/13 -	34 7/24 -			35 8/25 -			2 8/1 -			
35 9/2 -	49 8/15 -	34 7/25 -			35 8/31 -			2 8/2 -			
48 9/4 -	22 8/13 -	464 7/21 -			48 8/25 -			35 8/1 -			
792 9/1 -	22 8/14 -	AUGUST			618 8/24 -			48 8/2 -			
714 9/1 -	10 8/14 -	267 8/4 -			7 8/1 -			618 8/1 -			
	18 8/13 -	267 8/19 -			13 8/25 +			618 8/2 -			
	77 8/13 -	267 8/21 -			792 8/26 -			13 8/2 -			
	77 8/14 -	267 8/22 -			792 8/28 -			53 8/2 -			
	77 8/18 -	267 8/25 -			792 8/30 -			792 8/2 -			
	2096 8/18 -	8 8/4 -			714 8/26 -			714 8/1 -			
	4 8/14 -	315 8/4 -			714 8/28 -			714 8/2 -			
	35 8/14 -	315 8/19 -			714 8/30 -			61 8/2 -			
	35 8/17 -	315 8/20 -			34 8/1 -						
	618 8/14 -	315 8/22 -			34 8/24 -						
	618 8/10 -	1 8/4 -			61 8/1 -						
	7 8/13 +	49 8/4 -			61 8/28 -						
	46 8/14 -	49 8/19 -			61 8/30 -						
	53 8/18 -	49 8/20 -			61 8/31 -						
	792 8/14 -	60 8/19 -									
	34 8/14 -	60 8/20 -									
	34 8/18 -	60 8/22 -									
	61 8/14 -	22 8/19 -									
	61 8/15 -	22 8/20 -									
		22 8/22 -									
		10 8/4 -									
		18 8/6 -									
		18 8/21 -									
		18 8/23 -									
		77 8/4 -									
		77 8/5 -									
		77 8/9 -									
		77 8/21 -									
		77 8/23 -									
		6 8/3 -									
		2096 8/3 -									
		2096 8/19 -									
		2096 8/21 -									
		2096 8/22 -									
		2096 8/23 -									
		5 8/4 +									
		4 8/20 -									
		35 8/21 -									
		48 8/3 -									
		48 8/9 -									
		48 8/21 -									
		48 8/23 -									
		618 8/4 -									
		618 8/20 -									
		618 8/22 -									
		7 8/4 +									
		7 8/9 -									
		7 8/21 -									
		46 8/4 -									
		46 8/7 -									
		13 8/3 -									
		13 8/5 -									
		13 8/20 -									
		53 8/5 -									
		53 8/20 -									
		792 8/5 -									
		792 8/20 -									
		792 8/21 -									
		792 8/23 -									
		792 8/24 -									
		714 8/4 -									
		34 8/3 -									
		34 8/20 -									
		34 8/22 -									

this experiment during July, August and the first part of September 32 were found to contain the organism, detected in hens Nos. 10, 18, 6, 5, 2, 52, 13, 792, 8, 1, 2096, 7, 714, 267, 48 and 464. With hen No. 10, 11 eggs were tested, covering a laying period of seventeen days, before the organism was detected. With hen No. 18, 8 eggs were tested, covering a laying period of sixteen days prior to its detection. With hen No. 6, 5 eggs were tested, covering a laying period of six days. With hen No. 5, 12 eggs were tested, covering a laying period of twenty days. With the other 11 infected birds it varied from the 6th to the 21st egg laid before *Bacterium pullorum* was detected for the first time, and the laying periods varied from eight to sixty-one days (see Table 5 on page 10).

It is interesting to note at this point that all the hens, except 22, which were received from the Maryland Experiment Station, previously inoculated intravenously with a pure culture of *Bacterium pullorum*, after two years, showed positively the ovarian infection. This is in full agreement with the work of Dr. Jones, — that it is possible to cause local infection and cause such infection through the blood system.

As stated before, it has not been the primary object of these egg tests to make an exhaustive study of the value of diagnosis of ovarian infection by this method, but it has been of importance to determine by it if possible the number of these hens infected, to use as a check on the work on agglutination which was to follow.

Therefore, according to these tests hens Nos. 10, 8, 6, 5, 2, 52, 13, 792, 714, 8, 1, 2096, 7, 48 and 464 are all infected hens, the organism having been demonstrated conclusively in their eggs. It should also be stated that prior to starting experiments with these birds the organism had been detected in hen No. 267. From our work just cited it can be seen that in those hens which did lay eggs containing *Bact. pullorum*, the elimination from the ovary was so irregular that it would be impossible to make a diagnosis in a short time.

Since there was at hand such good material for study it was considered of importance to study the macroscopic agglutination test, as suggested by Jones [1, 2], — as regards the practicability of the tests, the test fluids and important steps to be observed in making the diagnosis, — and to carry out the test with three laboratory technicians to determine the value of this macroscopic test as a laboratory procedure for the diagnosis of this infection in adult hens.

This test depends upon the specific agglutinin elaborated in the blood serum of hens harboring the organism. The test requires a test fluid containing a suspension of *Bacterium pullorum* in 0.85 per cent. salt solution, preserved with 0.5 per cent. carbolic acid, and the specific agglutinin, diluted in varying amounts from suspected individuals. The agglutinins act on dead as well as living organisms.

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[1] Jones, F. S.: Report, New York State Veterinary College for 1910-11, p. 76.

[2] Jones, F. S.: "The value of the macroscopic agglutination test in detecting fowls that are harboring *Bact. pullorum*." Journal Medical Research, Vol. XXVII., No. 4; N. S., Vol. XXII., No. 4, pp. 485-495.

TABLE 5.

HEN NO.	No. OF EGGS LAID BEFORE B. PULLORUM WAS DETECTED	LAYING PERIOD IN DAYS
10	11	20
18	8	16
6	5	6
5	12	20
2	7	16
52	7	10
13	8	15
792	5	8
714	4	12
8	21	39
1	13	38
2096	21	33
7	11	24
48	19	58
464	12	61

From some preliminary tests it was found that the living test fluids gave little better results. For this reason it was decided to carry out our work, using the living organisms in preparing the various test fluids.

The Test Fluid.

Before preparing any of our test fluids for these macroscopic agglutination reactions, all strains of *Bacterium pullorum* were thoroughly tested out to establish their pathogenic powers. The *Bacterium pullorum* material had been isolated from 7 different sources, and was designated S_1 (Strain No. 1) S_2, S_3, S_4, S_5, S_6 and S_7, and represented cultures of *Bacterium pullorum* isolated by the author from chicks which had died of the disease from an infected flock of hens in western Massachusetts; from another chick, dead of the disease; from an infected flock of more than 400 hens from eastern Massachusetts; from a fresh egg laid by a hen in this infected flock; from the ovarian tissue of a badly infected hen in the State of Maryland; from a chick which had died after experimental inoculation with a pure culture isolated from ovarian tissue; from a strain isolated from Connecticut epidemics and furnished to the author three years ago by Dr. Rettger of Yale University. The last, or Strain No. 7, was recovered from a local epidemic. These strains were all carefully examined for purity, and after due time were obtained in a very active state of growth. Strain No. 4 was finally not used because it appeared to have lost so much of its virulence.

For testing the virulence of these 6 strains of *Bacterium pullorum* 154 day-old chicks, hatched July 10, 1913, were used. They were divided into 7 lots, 22 in each lot. Six of these sets were inoculated with *Bact. pullorum* and the seventh was used for control. The chicks were fed sterilized food and water and were retained in wire animal cages and brooded with stone jugs containing hot water. The litter used was fine shavings which had been sterilized and spread in a layer over floor of cages prior to putting the chicks in. Each chick in the lots to be infected received $\frac{1}{4}$ c.c. of a physiological saline suspension of the various strains of *Bacterium pullorum* subcutaneously. The control lot received $\frac{1}{4}$ c.c. sterile physiological salt solution administered in the same manner. Chicks in pen No. 1 were inoculated with S_1; chicks in pen No. 2, with S_2; chicks in pen No. 3, with S_3; chicks in pen No. 4, with S_5; chicks in pen No. 5, with S_6; chicks in pen No. 6, with S_7; and the chicks in pen No. 7 were the controls.

As soon as chicks died they were carefully autopsied and the liver, heart, unabsorbed yolk and calcar examined for presence of *Bacterium pullorum*. In Table 6 are arranged the mortality records which furnish the evidence of the pathogenicity of these various strains. From each chick, dead of the disease, cultures were retained, and in Table 6 P. signifies that the cultures were recovered from the respective organs in an absolutely pure state. Wherever there is a denotation N.P. it signifies that culture recovered was not pure. However, in no case did

the contaminating factor so outgrow or obscure the colony of *Bacterium pullorum* but that it was possible to recover it from some of the tubes. At this point it is sufficient to say that the symptoms — pre-mortem and post-mortem findings of chicks dead of the disease — correspond with those previously studied by the author.[1]

After twenty-five days the tests were considered completed, and Strains Nos. 1, 2, 3, 5, 6 and 7 were all in perfect condition to continue the work with the agglutinations. Pen No. 7, the control lot, never showed any signs of disease, and until a few weeks ago (Dec. 1, 1913) 20 of the 22 were living, healthy, vigorous birds. Only two deaths occurred among the 22 control chicks; one was accidental and the other was killed on account of lameness.

Making the Test Fluid.

Slant agar tubes were inoculated with *Bact. pullorum* and grown in incubator at 38° C. for one or two days. The growth was then washed with carbolated salt solution (0.85 per cent. salt solution containing 0.5 per cent. carbolic acid). The whole volume of washed material should have a very definite cloudy appearance. This was put in the shaking machine and shaken for one-half hour and then passed through sterile absorbent cotton to strain out any clumps of bacteria which might remain. Care should always be observed not to prepare the suspension too thin. A good test fluid should be uniformly turbid. This should be retained on ice or in lower part of refrigerator.

Method of obtaining Blood Serum.

At first the method of cutting a spike of the comb was employed, but since the bird's blood coagulates so quickly if in contact with tissue this was found unsatisfactory. Then the method of cutting the wing vein was employed, and by working carefully with this method it was found to be suitable in every respect for drawing blood in 2 to 10 c.c. quantities, causing but little effect upon the bird. At first great care was used in cutting through the cutaneous tissue until the *vena ulnaris* was reached, and the tissue teased away to make a clean cutting surface for making the incision into the vein. By such treatment it was possible to get the blood under quite ideal conditions, but the bird was submitted to considerable discomfort. Finally it was found that the quicker the cut was made the better the results, and less discomfort for the individual. The procedure finally adopted for drawing about 6 c.c. of blood in a very short time, and one which appeared to cause the individual no apparent discomfort, nor disturb the egg laying later on, was carried out as follows: the bird was laid on its side and the wing laid out near the edge of the table and turned downward to afford a grade for the sample of blood to flow into test tube.

[1] Gage, Geo. Edward: "Notes on ovarian infection with *Bacterium pullorum* (Rettger) in the domestic fowl." Journal Medical Research, Vol. XXIV., No. 3; N. S. Vol. XIX., No. 3; June, 1911, pp. 491-496.

TABLE 6.

Mortality Records of chicks on test to demonstrate pathogenicity of Bacterium pullorum S_1, S_2, S_3, S_5, S_6 and S_7

Pen no 1 - chicks inoculated subcutaneously with 0.25 c.c. physiological saline suspension Bact. pullorum Strain 1 22 in number.
(SEE LEGEND AT BOTTOM OF TABLE)

Chick No.	Date of Death	Heart	Liver	Unabsorbed Yolk	Caeca	Cultures purified and filed as No.
1	7-13-13	+ NP	+ P	—	—	H 1
2	7-13-13	+ NP	+ NP	+ NP	+ NP	H 2 L 3
3	7-13-13	+ P	+ P	+ NP	+ NP	H 4 L 5 U 6
4	7-14-13	+ N.P	+ NP	+ P		U 7
5	7-14 13	+ P	+ NP	+ NP	+ N.P	H 8 L 9
6	7-14. 13	+ NP	+ NP	+ NP	—	N 10 L 11
7	7-14-13	+ P	+ P	+ NP	+ NP	N 12 L 13 U 14
8	7-14-13	+ N.P	+ NP	+ NP	+ NP	L 15 U 16 C 17
9	7-14-13	+ P	+ P	+ N.P	+ N.P	H 18 L 19 U 20
10	7-14-13	+ N.P	+ NP	+ NP	+ N.P	L 21 U 22
11.	7-15-13	+ P	+ NP	+ P	+ NP	H 23 L 24 U 25
12	7-15-13	+ N.P	+ NP	+ N.P	+ NP	N 26 L 27 U 28 C 29
13	7-15-13	+ P	+ P	+ P	+ N.P	N 30 L 31 U 32
14	7-16 13	+ NP	+ P	+ N.P	+ N.P	L 33
15	7-16-13	+ NP	+ N.P	+ NP		N 34 L 35 U 36
16	7-16-13	+ N.P	+ N.P	+ N.P	+ N.P	H 37 L 38 U 39
17	7-16-13	— NP	— NP	+ NP		U 40
18	7-16-13	+ P	+ P	+ N.P	— NP	N 41 L 42 U 43
19	7-17-13	+ N.P.	+ NP			N 44 L 45
20						
21						
22						

Pen no 2 - chicks inoculated subcutaneously with 0.25 c.c physiological saline suspension Bact. pullorum Strain 2 22 in number

Chick No.	Date of Death	Heart	Liver	Unabsorbed Yolk	Caeca	Cultures purified and filed as No.
1	7-12-13	—	—	—	-	
2	7-14-13	— NP	+ N.P	+ P	— NP	L 46 U 47
3	7-14-13	+ NP	+ N.P	+ NP	— NP	N 48 L 49 U 50
4	7-15-13	+ P	+ P	+ NP	+ NP	N 51 L 52 U 53
5	7-15-13	+ N.P	+ NP	+ N.P	— NP	H 54 L 55 U 56
6	7-16-13	+ NP	+ P	+ NP	+ NP	L 57
7	7-16-13	+ NP	+ P	+ P		H 58 L 59 U 60
8	7-16-13	+ NP	+ NP	+ P	+ NP	H 61 L 62 U 63
9	7-16-13	+ NP	+ NP	+ P	+ NP	H 64 U 65
10	7-16-13	+ P	+ P	+ NP	+ NP	H 66 L 67
11	7-16-13	+ P	+ NP	+ P	+ P	H 68
12	7-17-13	+ NP	+ NP	?		U 69
13	7-17-13	+ P	+ P	+ NP	— NP	H 70 L 71 U 72
14	7-17-13	+ NP	+ NP			H 73
15	7-17-13	+ NP	+ NP	+ NP	+ NP	L 74 U 75 C 76
16	7-17-13	+	+ NP	+ NP	+ NP	U 77
17	7-17-13	+ NP	+ P	+ P	+ NP	L 78 U 79
18	7-18-13	+ NP	+ NP	+ NP	+ NP	L 80 U 81
19	7-21-13	+ P	+ P	+ NP	+ NP	L 82
20	7-23-13	+ NP	— NP	+ NP	+ NP	H 83
21						
22						

Pen no 3. - chicks inoculated subcutaneously with 0.25 c.c. physiological saline suspension Bact pullorum Strain 3 22 in number

Chick No.	Date of Death	Heart	Liver	Unabsorbed Yolk	Caeca	Cultures purified and filed as No.	Chick No.
1	7-12-13	—	—	—	—		1
2	7-14-13	— NP	+ NP	+ P	+ NP	H 84 L 85 U 85	2
3	7-14-13	— NP	+ P	+ NP	+ NP	L 87	3
4	7-14-13	— NP	+ NP	+ NP	+ NP	H 88 L 89	4
5	7-15-13	— NP	+ P	+ NP	+ NP	H 90 L 91 U 92	5
6	7-15-13	+ P	+ NP	+ NP	+ NP	N 93 L 94 C 95	6
7	7-16-13	+ NP	+ NP	+ NP	+ NP	U 96	7
8	7-16-13	+ NP	+ P	+ NP	+ NP	L 97	8
9	7-16-13	+ NP	+ NP	+ NP	+ NP	H 98 L 99 U 100	9
10	7-16-13	— NP	?	+ NP	?	N 101 U 102	10
11	7-16-13	+ NP	+ NP	+ NP	+ NP	H 103 L 104 U 105	11
12	7-16-13	+ P	+ P	+ P	+ NP	H 106 L 107 U 108 C 109	
13	7-17-13	+ P	+ NP	+ NP	+ NP	H 110 L 111 U 112	
14	7-17-13	?	+ P	+ NP	+ NP	L 113 U 114	
15	7-17-13	— NP	+ NP	+ NP	+ NP	L 115 U 116	
16	7-17-13	+ NP	—	+ NP	+ NP	H 117	
17	7-17-13	+ P	+ NP	+ NP	+ NP	N 118 L 119	
18	7-19-13	— NP	+ NP	+ NP	+ NP	N 120	
19	7-22-13	+ P	+ P	+ P	+ NP	N 121 L 122 U 123	

Pen no 4 - chicks inoculated subcutaneously with 0.25 c.c physiological saline suspension Bact pullorum Strain 5. 22 in number

Chick No.	Date of Death	Heart	Liver	Unabsorbed Yolk	Caeca	Culture purified and filed as No
1	7-13 13	— NP	+ NP	— NP	?	L 124
2	7-14 13	+ NP	+ NP	+ NP	+ NP	H 125 L 126 U 127 C 128
3	7-15 13	+ NP	+ NP	+ NP	+ NP	N 129 L 130
4	7-16-13	—	+ NP	—	+ NP	H 131 L 132 C 133
5	7-16-13	+ NP	+ P	+ NP	?	N 134 L 135 U 136
6	7-16 13	+ P	+ NP	+ P	+ NP	N 137 L 138 U 139 C 140
7	7-16 13	+ NP	+ NP	+ NP	+ NP	N 141 L 142 U 143 C 140
8	7 16 13	— NP	+ NP	+ NP	—	L 145 U 146
9	7 17-13	—	+ NP	+ NP	?	L 147 U 148
10	7-17-13	?	+ NP	+ NP	?	L 149 U 150
11	7-17-13	?	+ NP	+ P	+ NP	L 151 U 152 C 153

Pen no 5 - chicks inoculated subcutaneously with 0.25 c.c physiological saline suspension Bact. pullorum Strain 6 22 in number.

Chick No.	Date of Death	Heart	Liver	Unabsorbed Yolk	Caeca	Cultures purified and filed as No.
1	7-12 13	+ P	+ NP	+ P	+ NP	H 154 L 155 U 156
2	7-13-13	+ P	+ NP	+ P	+ NP	L 157 U 158
3	7-14-13	+ NP	+ P	+ NP	+ P	L 159 U 160
4	7-15 13	+ P	+ P	+ NP	+ P	L 161 U 162
5	7-15 13	+ P	+ P	+ P	+ P	H 163 L 164
6	7-15-13	+ P	+ P	+ P	+ P	H 165 L 166
7	7-15-13	+ P	+ NP	+ P	+	H 167 U 168
8	7-15 13	+ P	+ NP	+ P	+ NP	H 169 L 170 U 171 C 172
9	7-15-13	+ P	+ NP	+ P	+ NP	H 173 L 174 U 175
10	7-15-13	+ P	+ NP	+ P	+ NP	H 176 L 177 U 178
11	7-16-13	+ P	+ P	+ NP	+ NP	H 179 L 180 U 181
12	7-16 13	+ P	+ NP	+ P	+ NP	H 182 L 183
13	7-16 13	+ P	+ NP	+ P	+ NP	N 184 L 185 U 186
14	7-16 13	+ NP	+ NP	+ P	+ NP	U 187

Pen no 6 - chicks inoculated subcutaneously with 0.25 c.c physiological Saline suspension Bact. pullorum Strain 7, 22 in number

Chick No.	Date of Death	Heart	Liver	Unabsorbed Yolk	Caeca	Culture purified and filed as No
1	7-13 13	+ NP	—	+ NP	?	N 188 U 189
2	7 14-13	+ NP	— NP	+ P	?	N 190 U 191
3	7-15 13	+ NP	+ NP	+ NP	+ NP	H 192 U 193
4	7 15 13	+ P	+ NP	+ NP	+ NP	N 194 L 195
5	7-16-13		+ P	+ P	· NP	L 196 U 197
6	7 16 13	+ NP	+ NP	+ NP	+ NP	L 198
7	7-16-13	—	— NP	+ P	+ NP	N 199 L 200 U 201 C 202
8	7-16-13	+ P	+ P	+ NP	+ NP	N 203 L 204 U 205
9	7-16-13	+ NP	+ NP	+ NP	+ NP	L 206 U 207
10	7-17-13	+ NP	+ NP	+ NP	?	N 208 U 209
11	7-17 13		+ NP	+ NP	+ NP	L 210 U 211
12	7-18-13	+	+ NP	+ NP		L 212 U 213
13	7-21-13	+ NP	+ NP	+ NP		H 214 L 215 U 216
14	7-25-13	—	—	—	—	
15	7-28 13	—	+ P		—	L 217

LEGEND
+ = Bacterium pullorum detected
— = Bacterium pullorum not detected
P = signifies isolated in absolutely pure culture
NP = signifies culture showed some sign of contamination
H = culture isolated from heart
L = Culture recovered from liver
U = Culture isolated from unabsorbed yolk
C = Culture recovered from caeca. (signifying from either right or left)

The finger of the operator was placed under the *vena ulnaris*, between the ulnal and radial bones near the distal ends, and pressed until the vein by distention shows plainly. Then having sterilized the part, and using sterile fine scissors, a cut was made through the cutaneous tissue into the vein, making a short cut longitudinally. The blood will flow out in large drops, and can be easily collected into a test tube, and by using a pledget of cotton moistened with 1–40 carbolic acid the flow of blood can be quickly stopped, and then by placing a dry piece of cotton over the incision and closing the wing down tightly, in a few minutes the individual may be returned to the pen. Blood thus obtained is allowed to clot, and the serum is later drawn off as a straw-colored supernatant fluid. This is then diluted with carbolated salt solution to the usual stock dilution 1–20.

Making the Agglutination Test.

Small test tubes 4 inches long and $\frac{1}{2}$-inch calibre were used. During some of our preliminary tests 3 c.c. test fluid was used as suggested by Jones,[1] but it was found after several sets had been tried out that 1.5 c.c. of the test fluid gave equally good results. The dilutions used most were 1–100, 1–200 and 1–500, but in some of the work test dilutions from 1–100 to 1–5,000 were used and made as follows: all sera were diluted 1–20, and then by a simple algebraic calculation the amount of diluted (1–20) serum necessary to add to 1.5 c.c. test fluid to make a desired dilution was determined. For example, 1.5 c.c. test fluid + .3 c.c. (1–20 serum) = dilution 1–100 desired. The following amounts of diluted 1–20 serum were added to 1.5 c.c. test fluid to make required dilutions: —

1– 100 = .3 c.c. diluted serum 1–20.
1– 200 = .15 c.c. diluted serum 1–20.
1– 300 = .099 c.c. diluted serum 1–20.
1– 400 = .075 c.c. diluted serum 1–20.
1– 500 = .06 c.c. diluted serum 1–20.
1– 800 = .037 c.c. diluted serum 1–20.
1–1,000 = .03 c.c. diluted serum 1–20.
1–1,200 = .025 c.c. diluted serum 1–20.
1–1,500 = .019 c.c. diluted serum 1–20.
1–1,800 = .016 c.c. diluted serum 1–20.
1–2,000 = .015 c.c. diluted serum 1–20.
1–2,500 = .012 c.c. diluted serum 1–20.
1–3,000 = .009 c.c. diluted serum 1–20.
1–4,000 = .007 c.c. diluted serum 1–20.
1–5,000 = .006 c.c. diluted serum 1–20.

Three sets of graduated pipettes were used, the first, a 5 c.c. graduated to $\frac{1}{10}$ c.c.; the second, graduated to $\frac{1}{100}$ c.c. The pipette graduated to $\frac{1}{100}$ c.c. was used to make dilutions up to 1–500, and for dilutions 1–500 to 1–5,000 one divided into $\frac{1}{1000}$ of c.c. was employed. After having made

[1] Jones, F. S.: "The value of the macroscopic agglutination test in detecting fowls that are harboring *Bact. pullorum*." Journal Medical Research, Vol. XXVII., No. 4; N. S., Vol. XXII., No. 4, pp. 485-495.

the desired dilution and thoroughly shaken each tube to afford a complete mixture of the agglutinative sera and *Bacterium pullorum* all was placed in the bacteriological incubator at 38° and readings made of the macroscopic agglutinative picture at the end of twenty-four, forty-eight and seventy-two hours. All tests were controlled, *i.e.*, test fluid and agglutinative sera.

A positive macroscopic agglutination reaction is evident when the formation of fine, flake-like masses settle to the bottom of the tube into uneven heaped-up masses at the bottom and sides, leaving the supernatant fluid clear. This reaction is usually very prompt, and with sera of marked potency it is very clear and definitely defined. Controls should always be kept for check of test fluid, and check of diluted serum in carbolated salt solution.

The test fluid used for our work at first was composed of the 6 tested strains of *Bacterium pullorum* preserved by 0.5 per cent. carbolic acid and kept on ice. The serum was used continuously until no positive reactions would result in a serum known to be positive, and from this it was possible to determine about how long a serum could be retained under proper conditions and be in an active state for use in making the test.

In tables 7 and 8 which follow can be seen the results of the macroscopic tests on the birds carried out by three different technicians working independently. The technician is denoted in the column of that legend as 1, 2 and 3. It is indeed interesting to note that the work of the three technicians checks very well, and from the summary of the work of each no difference ever arose as to whether a bird was or was not a reactor. Hens Nos. 267, 8, 1, 10, 6, 2096, 10, 18, 6, 2, 48, 7, 13, 53, 792, 714, 464 and 61 were all proven by all three technicians to be infected hens, having the agglutinin present, varying in its powers to cause agglutination of *Bacterium pullorum*. From tables 7 and 8 it can be seen that with the results in the agglutination work, especially the s made with the blood drawn on July 19, and with the serum of hens Nos. 267, 2, 10, 2096, 5, 2, 48, 52, 53, 452, 792, 714 and 464, the serum reactions were consistent with the three technicians until the seventeenth or eighteenth days, when the reactions began to vary considerably. This is indeed an interesting feature in favor of the test, and it is possible, under better conditions of preservation, that it may be kept longer. After the hundreds of tests made in this laboratory it would be safe to state that properly preserved and cooled agglutinative sera may be retained in a good state for subsequent tests for as long as two weeks. On the other hand, a carefully prepared test fluid, made from newly incubated cultures of *Bact. pullorum*, and suspended in 0.85 per cent. physiological saline solution containing 0.5 per cent. phenol, if retained on ice will remain in good condition for making the tests even after two months.

In some instances a serum retained for three weeks, when used by one technician on the 6th of August reacted, and had lost its agglutinative powers on the 7th when used by another technician. At the beginning

Table 7.

AGGLUTINATION TESTS MADE WITH SERUM REMOVED JULY 3, 1913 AND TEST FLUID COMPOSED OF S_1 S_2 S_3 S_5 S_6 & S_7

Hen	Date	Technician	Hours	Dilutions					Hen	Date	Technician	Hours	Dilutions		
HEN 267	[illegible]	1	24	+	+	−			HEN 48	[illegible]	1	24	−	−	−
	[illegible]	2	24	+	+	−				[illegible]	2	24	−	−	−
	[illegible]	3	24	+	−	−				[illegible]	3	24	−	−	−
	[illegible]	1	48	+	+	+				[illegible]	1	48	−	−	−
	[illegible]	2	48	+	+	+				[illegible]	2	48	−	−	−
	[illegible]	3	48	+	+	−				[illegible]	3	48	−	−	−
	[illegible]	1	72	+	+	+				[illegible]	1	72	+	+	+
	[illegible]	2	72	+	+	+				[illegible]	2	72	+	+	+
	[illegible]	3	72	+	+	−				[illegible]	3	72	+	+	+
HEN 9	[illegible]	1	24	−	−	−			HEN 7	[illegible]	1	24	−	−	−
	[illegible]	2	24	−	−	−				[illegible]	2	24	−	−	−
	[illegible]	3	24	−	−	−				[illegible]	3	24	−	−	−
	[illegible]	1	48	+	+	+	+ + +			[illegible]	1	48	+	+	+
	[illegible]	2	48	+	+	+				[illegible]	2	48	+	+	+
	[illegible]	3	48	+	+	+				[illegible]	3	48	+	+	−
	[illegible]	1	72	+	+	+	+ + +			[illegible]	1	72	+	+	+
	[illegible]	2	72	+	+	+				[illegible]	2	72	+	+	+
	[illegible]	3	72	+	+	+				[illegible]	3	72	+	+	+
HEN 1	[illegible]	1	24	+	+	−			HEN 46	[illegible]	1	24	−	−	−
	[illegible]	2	24	+	+	−				[illegible]	2	24	−	−	−
	[illegible]	3	24	+	+	−				[illegible]	3	24	−	−	−

AGGLUTINATION TESTS MADE WITH BLOOD SERUM REMOVED JULY 19, 1913 AND A TEST FLUID COMPOSED OF S_1 S_2 S_3 S_5 S_6 AND S_7

Hen	Date	Technician	Hours	Dilutions
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 8.

AGGLUTINATION TESTS MADE WITH BLOOD SERUM REMOVED AUG 11, 1913. AND A TEST FLUID COMPOSED OF S_1, S_2, S_3, S_5, S_6, AND S_7.

Hen	Date	Technician	Hours	1:100	1:200	1:300	1:400	1:500	1:800	1:1000	1:1200	1:1400	1:1600	1:2000	1:2500	1:3000	1:4000	1:5000
HEN 267	8/12	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	24	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	+	+			-		-								
	8/19	2	48	+	+			-		-								
	8/19	2	72	+	+			-		-								
	8/20	1	24	+	+			+	+	+								
	8/20	2	24	+	-			-		-								
	8/20	1	48															
	8/20	2	48	+	+			-		-								
	8/20	1	72	+	+			-	-	-								
	8/20	2	72	+	+			+		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	+	-			-		-		-						
	8/25	2	72	+	+			-		-		-						
HEN 8	8/12		24															
	8/12		48															
	8/12		72															
	8/16	2	24	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
	8/16	2	48	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
	8/16	2	48	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
	8/19	2	24	+	+	+	+	+	+	+								
	8/19	2	48	+	+	+	+	+	+	+								
	8/19	2	72	+	+	+	+	+	+	+								
	8/20	1	24	+	+	+	+	+	+	+								
	8/20	2	24	+	+	+	+	+	+	+								
	8/20	1	48	+	+	+	+	+	+	+								
	8/20	2	48	+	+	+	+	+	+	+								
	8/20	1	72	+	+	+	+	+	+	+								
	8/20	2	72	+	+	+	+	+	+	+								
	8/25	2	24	+	+	+	+	+	+	+	+	+						
	8/25	2	48	+	+	+	+	+	+	+	+	+						
	8/25	2	72	+	+	+	+	+	+	+	+	+						
HEN 315	8/13	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	72															
	8/17	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	1	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	48	-	-	-	-	-	-	-	-	-						
	8/17	1	72	-	-	-	-	-	-	-	-	-						
	8/19	2	72	-	-	-	-	-	-	-	-	-						
	8/20	1	24	-	-	-	-	-	-	-	-	-						
	8/20	2	24	-	-	-	-	-	-	-	-	-						
	8/20	1	48															
	8/20	2	48	-	-	-	-	-	-	-	-	-						
	8/20	1	72															
	8/20	2	72	-	-	-	-	-	-	-	-	-						
	8/25	2	24	-	-	-	-	-	-	-	-	-						
	8/25	2	48	-	-	-	-	-	-	-	-	-						
	8/25	2	72	-	-	-	-	-	-	-	-	-						
HEN 1	8/12	2	24	-	-	-	-	-	-	-	-	-						
	8/12	2	48	-	-	-	-	-	-	-	-	-						
	8/12	2	72	+	+	+	+	+	+	+	-	-						
	8/17	1	24	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
	8/19	2	24															
	8/17	1	48	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	8/19	2	48	+	+	+	+	+	+	+								
	8/17	1	72															
	8/19	2	72	+	+	+	+	+	+	+								
	8/22	1	24	+	+			+	+	+								
	8/20	2	24	+	+			+										
	8/22	1	48	+	+			+	+	+								
	8/20	2	48	+	+			+		+								
	8/22	1	72															
	8/20	2	72	+	+			+		+								
	8/25	2	24	+	+			+		+								
	8/25	2	48	+	+			+		+		+						
	8/25	2	72	+	+			+		+		+	-	-				
HEN 49	8/12	2	24	-	-	-	-	-	-	-	-	-	-	-				
	8/12	2	48	-	-	-	-	-	-	-	-	-	-	-				
	8/12	2	72	-	-	-	-	-	-	-	-	-	-	-				
	8/16	2	24	-	-	-	-	-	-	-	-	-	-	-				
	8/16	2	48	-	-	-	-	-	-	-	-	-	-	-	-			
	8/16	2	72	-	-	-	-	-	-	-	-	-	-	-				
	8/19	2	24	-	-			-		-								
	8/19	2	48	-	-			-		-								
	8/19	2	72	-	-			-		-								
	8/20	1	24	-	-			-	-	-								
	8/20	2	24	-	-			-		-								
	8/20	1	48	-	-			-		-								
	8/20	2	48	-	-			-	-	-								
	8/20	1	72	-	-			-	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-								
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-		-		-	-	-				
HEN 60	8/13	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	72															
	8/17	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-			-	-	-								
	8/17	1	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	48	-	-			-		-								
	8/17	1	72															
	8/19	2	72	-	-			-		-								
	8/20	1	24	-	-			-	-	-								
	8/20	2	24	-	-			-		-								
	8/20	1	48	-	-			-	-	-								
	8/20	2	48	-	-			-	-	-								
	8/20	1	72	-	-			-		-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-								
	8/25	2	48	-	-			-		-								
	8/25	2	72	-	-			-		-								
HEN 22	8/12	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-			-		-								
	8/19	2	48	-	-			-		-								
	8/19	2	72	-	-			-		-								
	8/20	1	24	-	-			-		-								
	8/20	2	24	-	-			-		-								
	8/20	1	48	-	-			-	-	-								
	8/20	2	48	-	-			-		-								
	8/20	1	72	-	-			-	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-		-		-	-	-				
HEN 10	8/12	2	24															
	8/12	2	48															
	8/12	2	72															
	8/16	2	24	+	+	+	-	-	-	-	-	-	-	-				
	8/16	2	48	+	+	+	+	-	-	-	-	-	-					
	8/16	2	72	+	+	+	+	+	-	-	-	-	-					
	8/19	2	24	+	+			+		+								
	8/19	2	48	+	+			+		+								
	8/19	2	72	+	+			+		+								
	8/20	1	24	+	+			+	+	+								
	8/20	2	24	+	+			+		-								
	8/20	1	48	+	+			+	+	+								
	8/20	2	48	+	+			+		+								
	8/20	1	72	+	+			+	+	+								
	8/20	2	72	+	+			+		+								
	8/25	2	24	+	+			+		+		+						
	8/25	2	48	+	+			+		+		+						
	8/25	2	72	+	+			+		+		+						
HEN 18	8/13	2	24															
	8/13	2	48															
	8/13	2	72															
	8/19	2	24	-	-			-		-								
	8/19	2	48	+	+			+		+								
	8/19	2	72	+	+			+		+								
	8/17	1	24	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
	8/17	1	48	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-
	8/20	1	24	+	+				+		+							
	8/20	2	24	+	+			+			+							
	8/20	1	48															
	8/20	2	48	+	+			+		+								
	8/20	1	72	+	+			+	+	+								
	8/20	2	72	+	+			+		+								
	8/25	2	24	+	+			+		+		+						
	8/25	2	48	+	+			+		+		+	-	-				
	8/25	2	72	+	+			+		+		+	-	-				
HEN 77	8/12	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/17	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-			-										
	8/17	1	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	48	-	-			-										
	8/17	1	72															
	8/19	2	72	-	-			-		-								
	8/20	1	24	-	-			-	-	-								
	8/20	2	24	-	-			-		-								
	8/20	1	48															
	8/20	2	48	-	-			-		-								
	8/20	1	72	-	-			-	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-						
	8/25	2	72	-	-			-		-		-						
HEN 6	8/13	2	24	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	48	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	72	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
	8/16	2	24	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-
	8/19	2	24	+	+			+		+								
	8/19	2	48	+	+			+		+								
	8/19	2	72	+	+			+		+								
	8/20	1	24	+	+			+	+	+								
	8/20	2	24	+	+			-		-								
	8/20	1	48	-	+			+	+	+								
	8/20	2	48	+	+			+		-								
	8/20	1	72	+	+													
	8/20	2	72	+	+			+		+								
	8/25	2	24	+	+			+		+		+						
	8/25	2	48	+	+			+		+	+	+						
	8/25	2	72	+	+			+		+	+	+						
HEN 206	8/12	2	24	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	48	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	72	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	24	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	+	-	-		-	-	-								
	8/19	2	48	+	-	-		-	-	-								
	8/19	2	72	+	-	-		-	-	-								
	8/20	1	24	+	+			-	-	-								
	8/20	2	24	-	-			-		-								
	8/20	1	48	+	+			+	-	-								
	8/20	2	48	-	-			-		-								
	8/20	1	72	+	+			+	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-		-	-	-				
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-										
HEN 2	8/16	2	24	+	+	+												
	8/16	2	48	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
	8/16	2	72	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
	8/19	2	24	+	+			+		+								
	8/19	2	48	+	+			+		+								
	8/19	2	72	+	+			+		+								
	8/20	2	24	+	+			+		+								
	8/22	2	24	+	+			+	+	-								
	8/20	2	48	+	+			+		+								
	8/22	1	48	+	+			+	+	-								
	8/20	2	72	+	+			+		+								
	8/22	1	72															
	8/25	2	24	+	+			+		+		+						
	8/25	2	48	+	+			+		+		+						
	8/25	2	72	+	+			+		+		+	-	-				
HEN 4	8/13	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/17	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/17	1	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/17	1	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/20	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/20	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-		
	8/20	1	48	-	-	-	-	-	-	-	-	-	-	-	-	-		
	8/20	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-		
	8/20	1	72	-	-	-	-	-	-	-	-	-	-	-	-	-		
	8/20	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-		
	8/25	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-		
	8/25	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-		
	8/25	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-		
HEN 35	8/13	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	72															
	8/17	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-			-		-								
	8/17	1	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	48	-	-			-		-								
	8/19	1	72															
	8/19	2	72	-	-			-		-	-	-						
	8/20	1	24	-	-			-	-	-								
	8/20	2	24	-	-			-		-								
	8/20	1	48	-														
	8/20	2	48	-	-			-		-								
	8/20	1	72	-	-			-	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-								
	8/25	2	48	-	-			-		-								
	8/25	2	72	-	-			-		-								
HEN 48	8/16	2	24	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
	8/16	2	48	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
	8/16	2	72	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
	8/19	2	24	+	+			+		+								
	8/19	2	48	+	+			+		+								
	8/19	2	72	+	+			+		+								
	8/20	1	24	+	+			-	-	-								
	8/20	2	24	+	-			-	-	-								
	8/20	1	48	+	+			+	-	-								
	8/20	2	48	+	-			-		-								
	8/20	1	72	+	+			+	-	-								
	8/20	2	72	+	+			-		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-		-		-	-	-				
HEN 618	8/13	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/13	2	72															
	8/17	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-	-		-		-								
	8/17	1	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	48	-	-			-										
	8/17	1	72															
	8/19	2	72	-	-			-		-								
	8/20	1	24	-	-			-	-	-								
	8/20	2	24	-	-			-		-								
	8/20	1	48															
	8/20	2	48	-	-			-		-								
	8/20	1	72	-	-			-	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-	-	-				
HEN 7	8/12	2	24	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
	8/16	2	48	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
	8/16	2	72	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
	8/19	2	24	+	+			+		+								
	8/19	2	48	+	+			+		+								
	8/19	2	72	+	+			+		+								
	8/20	1	24	+	+			+	+	+								
	8/20	2	24	+	+			+		+								
	8/20	1	48	+	+			+	+	+								
	8/20	2	48	+	+			+		+								
	8/20	1	72	+	+			+	+	+								
	8/20	2	72	+	+			+		+								
	8/25	2	24	+	+			+		+		+						
	8/25	2	48	+	+			+		+		+	-	-				
	8/25	2	72	+	+			+		+		+	-	-				
HEN 46	8/12	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-			-		-								
	8/19	2	48	-	-			-		-								
	8/19	2	72	-	-			-		-								
	8/20	1	24	-	-			-		-								
	8/20	2	24	-	-			-		-								
	8/20	1	48	-	-			-		-								
	8/20	2	48	-	-			-	-	-								
	8/20	1	72	-	-			-	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-		-		-	-	-				
HEN 13	8/17	1	24	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
	8/19	2	24	+	+			+		+								
	8/17	1	48	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
	8/19	2	48	+	+			+		+								
	8/17	1	72															
	8/19	2	72	+	+			+		+								
	8/20	2	24	+	+			-		-								
	8/20	1	24	+	+			+	+	+								
	8/20	1	48	+	+			+	+	+								
	8/20	2	48	+	+			+		+								
	8/20	1	72	+	+			+	+	+								
	8/20	2	72	+	+			+		+								
	8/25	2	24	+	+			+		+								
	8/25	2	48	+	+			+		+	+	+	-	-				
	8/25	2	72	+	+			+		+	+	+	-	-				
HEN 53	8/19	2	24	-	-			-		-								
	8/19	2	48	+	+			+		+								
	8/19	2	72	+	+			+		+								
	8/20	2	24		-													
	8/20	2	48	+	+			+		+								
	8/20	2	72	+	+			+		+								
	8/25	2	24	+	+			+		+	-							
	8/25	2	48	+	+			+		+		+						
	8/25	2	72	+	+			+		+		+						
HEN 792	8/20	1	24	+	+			+	-	-								
	8/20	2	24	-	-			-	-	-								
	8/20	1	48	+	+			+	+	+								
	8/20	2	48	-	-			-		-								
	8/20	1	72	+	+			-	-	-								
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-		-		-	-	-				
HEN 114	8/16	2	24	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	+	-		-		-									
	8/19	2	48	+	+			-		-								
	8/19	2	72	+	+			-		-								
	8/20	1	24	+	+			+	-	-								
	8/20	2	24	+	-			-		-								
	8/20	1	48	+	+			+	-	-								
	8/20	2	48	+	+			-		-								
	8/20	1	72	+	+			-	-	-								
	8/20	2	72	+	+			+		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	+	+			+		-		-	-	-				
	8/25	2	72	+	-			+		-		-	-	-				
HEN 34	8/12	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/12	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	-	-	-		-		-								
	8/19	2	48	-	-			-		-								
	8/19	2	72	-	-			-		-								
	8/20	1	24	-	-			-	-	-								
	8/20	2	24	-	-			-	-	-								
	8/20	1	48	-	-			-	-	-								
	8/20	2	48	-	-			-										
	8/20	1	72															
	8/20	2	72	-	-			-		-								
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-		-		-	-	-				
HEN 464	8/16	2	24	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	48	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/16	2	72	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	+	+	-	-	-	-	-								
	8/19	2	48	+	+	-	-	-	-	-								
	8/19	2	72	+	+			-		-								
	8/20	2	24	+	+			-		-								
	8/22	1	24	+	+			+	+	+								
	8/20	2	48	+	+			-		-								
	8/22	1	48	+	+			+	+	+								
	8/20	2	72	+	+			-		-								
	8/22	1	72															
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	+	+			-		-		-	-	-				
	8/25	2	72	+	+			-		-		-	-	-				
HEN 61	8/17	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/19	2	24	+	+	-	-	-	-	-								
	8/17	1	48	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
	8/19	2	48	+	+	-	-	-	-	-	-	-						
	8/17	1	72															
	8/19	2	72	+	+			-		-	-	-						
	8/20	1	24															
	8/20	2	24	+	+			-		-								
	8/20	1	48															
	8/20	2	48	+	+			-		-	-	-						
	8/20	1	72	+	+			+	+	-								
	8/20	2	72	+	+			+		-	-	-						
	8/25	2	24	-	-			-		-		-						
	8/25	2	48	-	-			-		-		-	-	-				
	8/25	2	72	-	-			-		-		-	-	-				

of this work, the serum was divided into three portions, to serve the technicians for independent work. The period of making tests for one technician often required more time to which the serum was submitted to laboratory temperature than that of another, and this in a way perhaps explains the keeping quality of one portion over another. However, one can see from the tests made that comparatively recently drawn sera carefully retained on ice yielded the best results.

Hens Nos. 315, 49, 60, 22, 77, 4, 35, 618, 46 and 34 never gave a positive reaction during this work, and the work of all three technicians checks in this respect. The serum of Nos. 2096, 52 and 464 gave varying reactions after long retention of serum, but no trouble was experienced by any of the workers in concluding that these birds either were harboring or had harbored *Bacterium pullorum*.

It may be stated here that under the conditions of the tests, if the test fluid is prepared uniformly, the test carefully carried out, the macroscopic agglutination test for detecting the virus of *Bacterium pullorum* has proven a good laboratory method as handled by three laboratory technicians in this laboratory during the past summer.

The Influence of Test Fluids of Varying Composition (Monovalent and Polyvalent Test Fluids).

For these tests an experiment was planned in which the serum was used, drawn on the 19th of July. The test fluid was composed of equal quantities of the different strains of *Bacterium pullorum* used throughout this work. In the first experiment or test a test fluid containing S_1 was used; in the second, a test fluid containing S_2; in a third, a test fluid containing equal quantities S_1 and S_2; in a fourth, a test fluid containing equal quantities S_1, S_2 and S_3; in a fifth, a test fluid containing equal quantities S_1, S_2 and S_7; in a sixth, a test fluid containing S_1, S_2, S_3 and S_5; in a seventh, a test fluid containing S_1, S_2, S_3, S_5 and S_6; and in an eighth, a test fluid containing S_1, S_2, S_3, S_5, S_6 and S_7. Various dilutions of the serum were used, the dilutions being made as before. In most cases readings were made after twenty-four, forty-eight and seventy-two hours' incubation.

An analysis of Table 9 shows that the serum from all hens which had previously agglutinated gave consistent positive results in all the sera. Sera from hens Nos. 2096, 452, 792 and 5 appeared to give better results with a test fluid containing several strains of the organism. Although some of the positive reactors showed good reactions with a monovalent test fluid, yet from the data at hand it may be stated as justified that a test fluid containing several different strains is best suited, under most conditions, in laboratory routine for making the test. Here it should be noted that none of the birds previously tested and found negative reacted when their serum was mixed with the test fluids of the various compositions.

The birds Nos. 58, 59, 62 and 63 were cocks. Of these, 59, 62 and 63 gave questionable reactions, and 58 gave a very weak or slight reaction

of a positive nature. This is interesting, and it will require further study with this blood and work in connection with the autopsies of such birds to determine if the testicles of such individuals harbor the organism. The reactions with these birds were always very slight and questionable, and hardly comparable with the clearcut reactions exhibited when the blood serum from infected hens was used.

Comparison of Results of Macroscopic Agglutination Tests with Egg Analysis.

From the egg record table it can be seen that *Bacterium pullorum* was isolated 32 times from 619 eggs, and the individuals harboring such organisms, determined by eggs laid in July, were hen No. 10 on the 30th; hen No. 18 on the 26th; hen No. 6 on the 16th, 17th and 19th; hen No. 5 on the 30th; hen No. 2 on the 26th and 30th; hen No. 52 on the 21st and 23d; hen No. 13 on the 22d and 26th; hen No. 792 on the 23d, 25th and 30th; hen No. 714 on the 27th; and in August, besides these hens, hen No. 8 laid an egg containing *Bacterium pullorum* on the 18th; hen No. 1 on the 15th; hen No. 2096 on the 12th; hen No. 7 on the 4th and 13th; and in September, hen No. 48 on the 6th; hen No. 464 on the 13th and the 16th. Hen No. 452 died before an egg was laid which contained the organism, but at autopsy, when ova from this individual were crushed and inoculated into sterile bouillon and put in incubator at 38° C., the organism was detected later on the agar streaks. Hen No. 267 had previously been found to be infected by an egg test. Serum from all these hens caused agglutination of *Bacterium pullorum* test fluids, the results of three technicians being in agreement. The organism was not isolated from the ovarian tissue of hen Nos. 53 or 61, although both these hen's blood serum caused very active agglutination. This may suggest that the active infection had passed, and the agglutination test showed the results of the past active infection. On the other hand, hens Nos. 315, 49, 60, 22, 77, 4, 35, 618, 312, 46 and 34 never exhibited the organism in their eggs, nor did blood serum from these individuals cause agglutination of *Bact. pullorum*.

Post-mortem Findings of Some Reactors and Non-reactors.

After Oct. 1, 1913, hens Nos. 10, 5, 52, 1, 792, 464, 6 and 13, as reactors, were killed and the ovaries examined for the presence of *Bacterium pullorum*. All the reactors were not killed because it was desired to make further studies with the agglutinins. At the present time hens containing active agglutinative sera are retained at the laboratory under constant observation. Hen No. 10 at autopsy revealed a pathological ovary containing several retention cysts. *Bacterium pullorum* was isolated from this material by direct inoculation. Hen No. 52 at autopsy showed an ovary with retention cysts, and from material crushed in sterile bouillon *B. pullorum* was detected on all tubes streaked from such material. Then hens Nos. 1, 5, 6, 792, 464 and 13 were autopsied. All ovaries from these

TABLE 9.

AGGLUTINATION TESTS MADE WITH TEST FLUIDS OF DIFFERENT COMPOSITIONS

$S_1 - S_1 S_2 S_3 S_5 S_6 S_7$

TEST FLUID CONTAINS S_1

Hen No	Hrs	1-100 1-200 1-500 1-1000
267	24	+ - - -
	48	+ + - -
	72	+ + - -
8	24	+ + - -
	48	+ + + +
	72	+ + + +
315	24	- - - -
	48	- - - -
	72	- - - -
1	24	- - - -
	48	+ + - -
	72	+ + + +
49	24	- - - -
	48	- - - -
	72	+ - - -
60	24	- - - -
	48	+ - - -
	72	+ - - -
22	24	- - - -
	48	- - - -
	72	- - - -
10	24	+ - - -
	48	+ + + +
	72	+ + + +
18	24	- - - -
	48	+ + + +
	72	+ + + +
77	24	- - - -
	48	- - - -
	72	- - - -
6	24	+ + + +
	48	+ + + -
	72	+ + + +
2096	24	- - - -
	48	- - - -
	72	- - - -
2	24	+ + + +
	48	+ + + +
	72	+ + + +
4	24	+ + - -
	48	+ + - -
	72	+ + - -
35	24	- - - -
	48	- - - -
	72	- - - -
48	24	- - - -
	48	+ - - -
	72	+ + + +
618	24	- - - -
	48	- - - -
	72	- - - -
7	24	+ + + +
	48	+ + + -
	72	+ + + +
46	24	- - - -
	48	- - - -
	72	- - - -
13	24	+ + + +
	48	+ + + +
	72	+ + + +
53	24	- - - -
	48	- - - -
	72	+ + + +
792	24	- - - -
	48	- - - -
	72	- - - -
714	24	+ - - -
	48	+ - - -
	72	+ - - -
34	24	- - - -
	48	- - - -
	72	- - - -
464	24	+ - - -
	48	+ - - -
	72	+ - - -
61	24	+ + - -
	48	+ - - -
	72	+ - - -
58	24	- - - -
	48	+? - - -
	72	+? - - -
59	48	- - - -
	24	- - - -
	72	- - - -
62	24	- - - -
	48	- - - -
	72	- - - -
63	24	- - - -
	48	- - - -
	72	- - - -

TEST FLUID CONTAINS S_2

Hen No	Hrs	Agglutination
267	24	- - -
	48	- - -
	72	- - -
8	24	+ + +
	48	+ + +
	72	+ + +
315	24	- -
	48	- -
	72	- -
1	24	+ - -
	48	+ + -
	72	+ + +
60	24	- - -
	48	- - -
	72	- - -
10	24	- - -
	48	- - -
	72	- - -
18	24	+ + -
	48	+ + +
	72	+ + -
77	24	- - -
	48	- - -
	72	- - -
6	24	+ - -
	48	+ - -
	72	+ - -
2096	24	- - -
	48	- - -
	72	- - -
5	24	- -
	48	- -
	72	+ +
2	24	+ + + - - -
	48	+ + + - - -
	72	+ + + - - -
4	24	- - -
	48	- - -
	72	- - -
35	24	- - -
	48	- - -
	72	- - -
48	24	- - -
	48	- -
	72	- -
619	24	- - -
	48	- - -
	72	- - -
7	24	+ + + - - -
	48	+ + + + - -
	72	+ + + + - -
46	24	- -
	48	- -
	72	- -
52	24	- - -
	48	- - -
	72	- - -
13	24	+ + + +
	48	+ + + +
	72	+ + + +
53	24	+ + + - - -
	48	+ + + - - -
	72	+ + - - - -
452	24	+ + - - - -
	48	+ + - - - -
	72	+ + - - - -
792	24	- - -
	48	- - -
	72	- - -
714	24	- -
	48	- -
	72	- -
34	24	- - -
	48	- - -
	72	- -
464	24	+ + - - -
	48	+ + - - -
	72	+ + - - -

TEST FLUID CONTAINS $S_1 + S_2$

Hen No	Hrs	Agglutination
267	24	+ - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	+ - - - - - - - - - - - - - - -
8	24	+ + + + + + + + + + - - - - - -
	48	+ + + + + + + - - - - - - - - -
	72	+ + + + + + + + - - - - - - - -
315	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
1	24	+ + + + + + + + + + + + + + + +
	48	+ + + + + + + + + + + + + + + +
49	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	- - - - - - - - - - - - - - - -
60	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
22	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
10	24	+ + - - - - - - - - - - - - - -
	48	+ + + - - - - - - - - - - - - -
	72	+ + + - - - - - - - - - - - - -
18	24	+ + + + + + + + + + + + - - - -
	48	+ + + + + + + + + - - - - - - -
77	24	- - - - - - - - - - - - - - - -
6	24	+ + + + + - - - - - - - - - - -
	48	+ + + + + + - - - - - - - - - -
	72	+ + + + + + + + - - - - - - - -
2096	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	+ - - - - - - - - - - - - - - -
2	24	+ - - - - - - - - - - - - - - -
	48	+ + + + + + + + - - - - - - - -
	72	+ + + + + + + + + + + - - - - -
4	24	- - - - - - - - - - - - - - - -
	48	+ - - - - - - - - - - - - - - -
35	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
48	24	- - - - - - - - - - - - - - - -
	48	+ - - - - - - - - - - - - - - -
	72	+ - - - - - - - - - - - - - - -
618	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
7	24	+ + + + + + + + + + + - - - - -
	48	+ + + + + + + + + + + - - - - -
	72	+ + + + + + + + + + - - - - - -
46	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	- - - - - - - - - - - - - - - -
13	24	+ + + - - - - - - - - - - - - -
	48	+ + + - - - - - - - - - - - - -
792	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	- - - - - - - - - - - - - - - -
714	24	+ - - - - - - - - - - - - - - -
	48	+ - - - - - - - - - - - - - - -
	72	+ - - - - - - - - - - - - - - -
34	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	- - - - - - - - - - - - - - - -
464	24	+ - - - - - - - - - - - - - - -
	48	+ - - - - - - - - - - - - - - -
	72	+ - - - - - - - - - - - - - - -
61	24	- - - - - - - - - - - - - - - -
	48	+ + + + + + + + - - - - - - - -
58	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
59	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
62	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
63	24	+? +? +? +? +? - - - - - - - - - - -
	48	+? +? +? +? - - - - - - - - - - - -

TEST FLUID CONTAINS $S_1 + S_2 + S_3$

Hen No	Hrs	Agglutination
267	24	+
	72	+ +
8	24	+ + + + + +
	48	+ + + + + +
	72	+ + + + + +
315	24	- - - - -
1	24	+ + + + + +
	48	+ + + + + +
49	24	- - - - -
	48	+ - - - -
	72	+ + + + -
60	24	- - - - -
	48	- - - - -
22	24	- - - - -
	48	- - - - -
	72	- - - - -
10	24	+ + + + +
	48	+ + + + +
	72	+ + + + +
18	24	+ + + + +
	72	+ + + + +
77	24	- - - - -
	72	- - - - -
6	24	+ + + + +
	48	+ + + + +
	72	+ + + + +
2096	24	+ + + + +
	48	+ - - - -
	72	+ - - - -
2	24	+ + + + +
	48	+ + + - -
4	24	+ + + - -
	72	+ + + - -
35	24	- - - - -
	72	- - - - -
48	24	+ + + - -
	48	+ + + - -
	72	+ + + - -
618	24	- - - - -
	72	- - - - -
7	24	+ + + + +
	48	+ + + + +
	72	+ + + + +
46	24	- - - - -
	48	- - - - -
	72	- - - - -
13	24	+ + + + +
	48	+ + + + +
	72	+ + + + +
13	24	+ + + + +
	48	+ + + + +
792	24	+ + + + +
	48	+ + + + +
	72	+ + + + +
714	24	+ + + + +
	48	+ + + + +
	72	- - - - -
34	24	- - - - -
	48	- - - - -
464	24	+ + + + +
	48	+ + + + +
617	2	+ + + + +
58	24	+ - - - -
	48	+ - - - -
	72	+ - - - -
59	24	- - - - -
	48	+? - - -
	72	+? - - -
62	24	+? +? +? +? -
	48	+? +? +? +? -
	72	+? +? +? +? -
63	24	+? +? +? +? -
	48	+? +? +? +? -
	72	+? +? +? +? -

TEST FLUID CONTAINS $S_1 + S_2 + S_7$

Hen No	Hrs	Agglutination
315	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
49	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	- - - - - - - - - - - - - - - -
60	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
22	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	- - - - - - - - - - - - - - - -
4	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
35	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
619	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
46	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
34	24	- - - - - - - - - - - - - - - -
	48	- - - - - - - - - - - - - - - -
	72	- - - - - - - - - - - - - - - -

TEST FLUID CONTAINS $S_1 + S_2 + S_3 + S_5$

Hen No	Hrs	Agglutination
267	24	+ - - -
	48	+ + - -
	72	+ + + -
8	24	+ + + +
	48	+ + + +
	72	+ + + +
315	24	- - - -
	48	+ - - -
	72	+ - - -
1	24	+ + + -
	48	+ + + +
	72	+ + + +
49	24	- - - -
	48	+ - - -
	72	+ - - -
60	24	- - - -
	48	- - - -
	72	+ - - -
22	24	- - - -
	48	- - - -
	72	- - - -
10	24	+ + + -
	48	+ + + +
	72	+ + + +
18	24	+ + + +
	48	+ + + +
	72	+ + + +
77	24	- - - -
	48	- - - -
	72	- - - -
6	24	+ + - -
	48	+ + + -
	72	+ + + +
2096	24	- - - -
	48	- - - -
	72	+ + + +
2	24	+ + + +
	48	+ + + +
	72	+ + + +
4	24	+ + - -
	48	+ + - -
	72	+ + - -
35	24	- - - -
	48	- - - -
	72	- - - -
48	24	- - - -
	48	+ - - -
	72	+ + - -
618	24	- - - -
	48	- - - -
	72	- - - -
7	24	+ + + +
	48	+ + + +
	72	+ + + +
46	24	- - - -
	48	- - - -
	72	- - - -
19	24	+ + - -
	48	+ + + +
	72	+ + + +
53	24	- - - -
	48	+ + + +
	72	+ + + +
792	24	- - - -
	48	- - - -
	72	+ + + -
714	24	+ - - -
	48	+ + - -
	72	+ + + -
34	24	- - - -
	48	- - - -
	72	- - - -
464	24	+ + - -
	48	+ + - -
	72	+ + - -
61	24	+ + - -
	48	+ + - -
	72	+ + + -
58	24	- - - -
	48	- - - -
	72	- - - -
59	24	+? - - -
	48	+? - - -
	72	+? - - -
62	24	- - - -
	48	- - - -
	72	- - - -
63	24	- - - -
	48	- - - -
	72	- - - -

TEST FLUID CONTAINS $S_1 + S_2 + S_3 + S_5 + S_6$

Hen No	Hrs	Agglutination	Hen No	Hrs	Agglutination
267	24	+ - -	267	24	- - - - -
	48	+ + -		48	- - - - -
	72	+ + -		72	+ + - - -
8	24	- - -	8	24	+ + + + +
	48	+ + +		48	+ + + + +
	72	+ + +		72	+ + + + +
315	24	- - - - -			
	48	+ - - - -			
	72	+ - - - -			
1	24	+ + -	1	24	+ + + + -
	48	+ + +		48	+ + + + +
	72	+ + +		72	+ + + + +
49	24	- - -	49	24	- - - - -
	48	- - -		48	- - - - -
	72	- - -		72	- - - - -
60	24	- - - - -			
	48	- - - - -			
	72	- - - - -			
22	24	- - -	22	24	- - - - -
	48	+ + -		48	- - - - -
	72	+ + -		72	- - - - -
10	24	+ - -	10	24	+ + + + +
	48	+ - -		48	+ + + + +
	72	+ + +		72	+ - + + +
18	24	+ + + + +			
	48	+ + + + +			
	72	+ + + + +			
77	24	- - - - -			
	48	- - - - -			
	72	- - - - -			
6	24	- - -	6	24	+ + + + +
	48	+ + +		48	+ + + + +
	72	+ + +		72	+ + + + +
2096	24	+ + +	2096	24	- - - - -
	48	+ + +		48	- - - - -
	72	+ + +		72	- - - - -
5	24	- - -			
	48	+ - -			
	72	+ + -			
2	24	- - -	2	24	+ + + + +
	48	- - -		48	+ + + + +
	72	- - -		72	+ + + + +
4	24	+ + + - -			
	48	+ + + - -			
	72	+ + + - -			
95	24	- - - - -			
	48	- - - - -			
	72	- - - - -			
48	24	- - -	48	24	- - - - -
	48	- - -		48	- - - - -
	72	- - -		72	- - - - -
618	24	- - - - -			
	48	- - - - -			
	72	- - - - -			
7	24	+ + + + +			
	48	+ + + + +			
	72	+ + + + +			
46	24	- - - -	46	24	- - -
	48	- - - -		48	- - -
	72	- - - -		72	- - -
13	24	+ + +	13	24	+ + + + +
	48	+ + +		48	+ + + + +
	72	+ + +		72	+ + + + +
53	24	+ + + + -			
	48	+ + + + +			
	72	+ + + + +			
452	24	- - -			
	48	+ - -			
	72	+ - -			
792	24	- - -	792	24	- - - - -
	48	- - -		48	- - - - -
	72	+ + -		72	- - - - -
714	24	+ + -	714	24	- - - - -
	48	+ + -		48	+ + + - -
	72	+ + -		72	+ + + - -
34	24	- - -	34	24	- - - - -
	48	- - -		48	- - - - -
	72	- - -		72	- - - - -
464	24	+ + +	464	24	- - - - -
	48	+ + +		48	+ + - - -
	72	+ + +		72	+ + - - -
61	24	- - - - - -	58	24	- - - - -
	48	- - - - -		48	- - - - -
	72	- - - - -		72	- - - - -
59	24	- - - - - -	62	24	- - - - -
	48	- - - - -		48	- - - - -
	72	- - - - -		72	- - - - -
63	24	- - - - -			
	48	- - - - -			
	72	- - - - -			

TEST FLUID CONTAINS $S_1 + S_2 + S_3 + S_5 + S_6 + S_7$

Hen No	Hrs	1-100 1-200 1-500	Hrs	1-100 1-200 1-500	Hrs	1-100 1-200 1-500	Hrs	1-100 1-200 1-500	Hrs	1-100 1-200 1-500	Hrs	1-100 1-200 1-500	Hrs	1-100 1-200 1-500	Hrs	1-100 1-200 1-500
267	24	+ + -	72	+ + +	48	+ + +	24	- - -	72	+ + -	24	- - -	48	- - -	72	- - -
	24	+ + -	72	+ + +	48	- - -	24	+ + -	24	- - -	24	- - -	48	- - -	72	- - -
	48	+ + +	24	- - -	72	+ + -	48	+ + -	48	+ + -	24	- - -	48	- - -	72	- - -
	48	+ + +	24	- - -			48	+ + -	72	+ + -						
8	24	- - -	72	+ + +	48	+ + +	24	+ + +	72	+ + +	24	- - -	48	+ + +	72	+ + -
	24	- - -	72	+ + +	48	+ + +	24	+ + +	24	+ + +	24	- - -	48	+ + -	72	- - -
	48	+ + +	24	+ + +	72	+ + +	48	+ + +	48	+ + +	24	- - -	48	- - -	72	- - -
	48	+ + +	24	+ + +			48	+ + +	72	+ + +						
315	24	- - -	72	- - -	24	- - -	24	- - -	24	- - -	48	- - -	72	- - -		
	24	- - -	72	- - -	48	- - -	48	- - -	24	- - -	48	- - -	72	- - -		
	48	- - -			72	+ + -	72	- - -	24	- - -	48	- - -	72	- - -		
	48	- - -														
1	24	+ + -	72	+ + +	48	+ + +	24	+ + +	72	+ + +	24	+ - -	48	+ - -	72	+ + -
	24	+ - -	72	+ + +	48	+ + +	48	+ + +	24	+ - -	24	+ - -	48	+ + -	72	+ + +
	48	+ + +	24	+ + -	72	+ + +	48	+ + +	48	+ + +	24	- - -	48	+ + -	72	+ + -
	48	+ - -	24	+ + +	24	+ + +	72	+ + +	72	+ + +						
49	24	- -	48	- - -	72	- - -	48	- - -								
	24	- - -	48	- - -	24	- - -	72	- - -								
60	24	- - -	48	- - -	24	- - -	24	- - -	24	- - -	48	- - -	72	- - -		
	24	- - -	72	- - -	48	- - -	48	- - -	24	- - -	48	- - -	72	- - -		
	48	- - -	72	- - -	72	- - -	72	- - -	24	- - -	48	- - -	72	- - -		
22	24	- - -	48	- - -	72	+ + -	48	- - -								
	24	- - -	48	- - -	24	- - -	72	- - -								
10	24	+ + -	72	+ + +	48	+ + +	24	+ + +	72	+ + +	72	+ + +	48	- - -	72	- - -
	24	+ + -	72	+ + +	48	+ + +	24	+ + +	72	+ + +	24	- - -	48	- - -	72	- - -
	48	+ + +	24	+ + -	72	+ + +	48	+ + +	24	- - -	24	- - -	48	- - -	72	- - -
	48	+ + +	24	+ + +			48	+ + +	48	+ - -	24	- - -				
18	24	+ + +	48	+ + +	24	+ + +	48	+ + +	24	+ - -	24	+ - -	48	- - -	72	- - -
	24	+ + +	48	+ + +	24	- - -	72	+ + +	48	+ + -	24	+ + -	48	+ + -	72	+ + -
			72	+ + +	48	+ + +	72	+ + +	72	+ + +	24	+ - -	48	+ - -	72	+ - -
77	24	- - -	48	- - -	24	- - -	24	- - -	24	- - -	48	- - -	72	- - -		
	24	- - -	72	- - -	48	- - -	48	- - -	24	- - -	48	- - -	72	- - -		
	48	- - -	72	- - -	72	- - -	72	- - -	24	- - -	48	- - -	72	- - -		
6	24	- - -	48	+ + +	24	+ + -	48	+ + +	24	+ + +	24	+ + -	24	+ + +	48	+ + +
	24	- - -	72	+ + +	24	+ + -	48	+ - +	48	+ + +	48	+ - -	24	+ + +	72	+ + +
	48	+ + -	72	+ + +	48	+ + +	72	+ + +	72	+ + +	72	+ + -	48	+ + +	72	+ + +
2096	24	+ + -	72	+ + +	48	+ + -	24	- - -	72	+ + -	24	- - -	48	- - -	72	- - -
	24	+ + -	72	+ + +	48	+ - -	24	+ + +	24	+ + +	24	- - -	48	- - -	72	- - -
	48	+ + -	24	+ - -	72	+ - -	48	- - -	48	- - -	24	- - -	48	- - -	72	- - -
	48	+ + -	24	- - -	72	+ + -	48	+ + +	72	- - -						
5	24	- - -	48	- - -	24	+ - -	48	- - -	24	- - -	24	+ - -	24	- - -	48	- - -
	24	- - -	48	- - -	24	- - -	72	+ + -	48	- - -	48	+ + -	24	- - -	72	- - -
			72	- - -	48	+ + -	72	- - -	72	+ + -	72	- - -	48	- - -	72	- - -
											24	- - -	48	- - -	72	- - -
2	24	- - -	72	+ + +	48	+ + -	24	+ + -	72	+ + -	24	+ + -	48	+ + -	72	+ + +
	24	- - -	72	+ + +	48	+ + -	24	+ + -	24	- - -	24	+ + -	48	+ + -	72	+ + +
	48	- - -	24	+ - -	72	+ + +	48	+ + +	48	+ - -	24	+ + +	48	+ + -	72	+ + +
	48	- - -	24	+ + -	72	+ + +	48	+ + +	72	+ + +						
4	24	- - -	48	- - -	24	- - -	24	- - -	24	- - -	48	- - -	72	- - -		
	24	- - -	72	- - -	48	- - -	48	- - -	24	- - -	48	- - -	72	- - -		
	48	- - -	72	- - -	72	- - -	72	- - -	24	- - -	48	- - -	72	- - -		
35	24	- - -	48	- - -	24	- - -	48	- - -	24	- - -	24	- - -	48	+ + -	72	- - -
	24	- - -	72	- - -	24	+ + -	72	+ + -	48	- - -	24	- - -	48	- - -	72	- - -
	48	- - -	72		48	- - -	72	- - -	72	- - -	24	- - -	48	- - -	72	- - -
48	24	- - -	72	+ + +	48	- - -	24	- - -	72	+ - -	24	+ + -	48	+ + -	72	+ + -
	24	- - -	72	+ + +	48	+ - -	24	- - -	24	+ + -	24	+ + -	48	+ - -	72	+ + -
	48	- - -	24	- - -	72	+ + -	48	+ + +	48	+ + -	24	+ + -	48	+ + +	72	+ + +
	48	- - -	24	- - -	72	+ + -	48	- - -	72	+ + -						
618	24	- - -	72	- - -	24	- - -	24	- - -	24	- - -	24	- - -	48	- - -	72	- - -
	24	- - -	24	- - -	48	- - -	48	- - -	48	- - -	24	- - -	48	- - -	72	- - -
	48	- - -	48	- - -	72	- - -	72	- - -	72	- - -	24	- - -	48	- - -	72	- - -
	48	- - -	72	- - -												
7	24	- - -	72	+ + +	48	+ + +	24	+ + +	72	+ + +	24	+ + +	48	+ + +	72	+ + +
	24	- - -	72	+ + +	48	+ + +	24	+ - -	24		24	+ + +	48	+ + +	72	+ + +
	48	+ + +	24	+ + -	72	+ + +	48	+ + -	48	+ + +	24	+ + +	48	+ + +	72	+ + +
	48	+ + +	24		72	+ + +	48	+ + -	72	+ + +						
46	24	- - -	72	+ - -	48	- - -	24	+ - -	24	- - -	24	- - -	48	- - -	72	- - -
	24	- - -	24	- - -	72	- - -	48	- - -	48	- - -	24	- - -	48	- - -	72	- - -
	48	- - -	24	- - -	72	- - -	72	+ - -	72	- - -	24	- - -	48	- - -	72	- - -
	48	+ - -	48	- - -												
52	24		48	- - -	24	+ + -	24	- - -	24	- - -	48	- - -	72	- - -		
	24	- - -	72	+ + -	48	+ + -	48	- - -	24	- - -	48	- - -	72	- - -		
	48	- - -	72	- - -	72	+ + +	72	- - -	24	- - -	48	- - -	72	- - -		
13	24	- - -	72	+ + -	48	+ + +	24	+ - -	72	+ + +	24	+ + -	48	+ + -	72	+ + -
	24	- - -	72	+ + -	48	+ + -	24	+ + +	24	+ + +	24	+ + -	48	+ + -	72	+ + -
	48	- - -	24	+ + -	72	+ + -	48	+ + +	48	+ + +	24	+ + -	48	+ + -	72	+ - -
	48	+ - -	24	- - -	72	+ + -	48	+ + -	72	+ + -						
53	24	+ - -	48	+ + +	24	+ + -	48	+ + +	24	+ -	24	+ - -	48	+ + -	72	+ + +
	24	+ - -	72	+ + +	24	+ - -	72	+ + +	48	+ + -	24	+ + -	48	+ + -	72	+ + +
	48	+ + -	72	+ + +	48	+ + +	72	+ + +	72	+ + -	24	+ + -	48	+ + -	72	+ + +
452	24	+ + +	72	+ + +	48	- - -	24	- - -	72	+ + -	24	+ + -	48	+ + -	72	+ + -
	24	+ + -	72	+ + +	48	- - -	24	+ + +	24	+ + -	24	+ + -	48	+ + -	72	+ + -
	48	+ + +	24	- - -	72	+ - -	48	+ + +	48	+ + -	24	+ + -	48	+ + -	72	+ + -
	48	+ + +	24	- - -	72	+ + +	48	+ + -	72	+ - -						
792	24	+ + -	72	+ + -	48	- - -	24	- - -	72	+ - -	24	- - -	48	- - -	72	- - -
	48	+ + -	72	+ + +	48	- - -	24	- - -	24	- - -	24	- - -	48	- - -	72	- - -
	24	+ + +	24	- - -	72	+ - -	48	+ + +	48	- - -	24	- - -	48	- - -	72	- - -
	48	+ + +	24	- - -	72	+ + -	48	- - -	72	- - -						
464	24	+ + -	48	+ + +	24	+ + -	48	+ - -	24	+ + -	48	+ + +	48	- - -	24	- - -
	24	+ + +	72	+ + +	24	+ - -	72	+ + -	24	+ + +	72	+ + +	72	+ - -	48	+ - -
	48	+ + +	72	+ + -	48	+ + -	72	+ + -	48	+ + +	24	- - -	24	- - -	48	+ - -

hens were cystic, exhibiting cysts of varying sizes, and the color was from normal yellow to grayish green. Hen No. 5 showed the least pathological condition of the ovaries. Many ova here were quite normal, and exhibited the usual high-colored picture so characteristic of a healthy ovary. Material from hens Nos. 1, 5, 6, 792, 464, 13 and 452 (previously examined) yielded cultures of *Bacterium pullorum*. Hens Nos. 34, 315, 49, 312, 60, 22, 77, 4, 35, 618 and 46, whose sera had never agglutinated, and in whose eggs *Bacterium pullorum* had not been found, were autopsied. All ova were normal except that of 77, which showed grossly congestion. More than 100 agar tubes were streaked from these ovaries and from materials crushed in sterile bouillon and incubated, and all gave negative results for *B. pullorum*. Hen No. 53, a positive reactor, and hen No. 46, a non-reactor, were killed accidentally, so data on ovaries from these hens were not obtained. The pathological findings of the birds that agglutinated correspond well with those previously described, and especially with previous observations by the author in 1910,[1] and also substantiate the work of Jones.[2] All ovaries from these birds exhibited one or more retention cysts and several irregular lobulated cysts, and the color varied from shades of yellow to green.

Specificity of Bacterium Pullorum Agglutinin.

The first recognition of the agglutination reaction as a separate function of immune sera was by Gruber and Durham.[3] From the first these investigators had claimed specificity for the agglutination reaction, and for this reason it was utilized by Widal for the diagnosis of typhoid fever. Even by early workers it was observed that serum of animals immunized against one micro-organism would often agglutinate to a much less marked degree other closely related species. The serum of a typhoid-immune animal may agglutinate the typhoid bacillus in dilutions of 1–1,000 and higher, and *B. coli* in dilutions as high as 1–200. The normal agglutinative power of *B. coli* does not exceed 1–20. Therefore the specificity of the reaction for practical purposes is not destroyed if the proper dilutions are carried out, the degree or amount of agglutinin formation being always far higher for the specific organism causing the formation of the agglutinin than for closely related species.

After carrying out 300 tests with normal sera from birds known to have no infection, we feel justified in stating that in some instances we were able to obtain slight agglutinative reactions in dilutions of 1–25, but in no instance was there ever exhibited the slightest sign of the agglutination of *Bacterium pullorum* when dilutions 1–100 of normal serum from non-

[1] Gage, Geo. Edward: "Notes on ovarian infection with *Bacterium pullorum* (Rettger) in the domestic fowl." Journal Medical Research, Vol. XXIV., No. 3; N. S., Vol. XIX., No. 3; June, 1911, pp. 491–496.

[2] Jones, F. S.: "The value of the macroscopic agglutination test in detecting fowls that are harboring *Bact. pullorum*." Journal Medical Research, Vol. XXVII., No. 4; N. S., Vol. XXII., No. 4, pp. 485–495.

[3] Gruber and Durham: Münch med. Woch, 1906.

infected individuals were used. For this reason, in the work carried out here, the lowest diagnostic dilution was 1–100. If reaction resulted with *Bacterium pullorum* in this dilution it was considered positive, and the individual rated as a reactor.

Since *Bacterium pullorum* has been placed in the *B. coli-typhi-dysenteræ* group of bacteria it was considered of interest to determine if *Bacterium pullorum* agglutinative sera were specific for *Bacterium pullorum*. For these tests the best known members of the *B. coli-typhi* group of bacteria were used. The sera from two hens harboring the organism was drawn and diluted with carbolated salt solution 1–20. Test fluids of uniform turbidity were prepared, as previously for *Bacterium pullorum*, of the following organisms: *B. coli communis*, *B. coli communior*, *B. icteroides*, *B. enteritidis*, *B. paratyphi A.*, *B. paratyphi B.*, *B. typhi abdominalis*, *B. Fowl cholera*, *B. cloacæ*, *B. lactis aerogenes*, and lastly a test fluid of *Bacterium pullorum*. Complete sets of test tubes were made for each, and to each was added the amount of *Bacterium pullorum* agglutinative sera to give the required dilution. The dilutions in all sets were from 1–100 to 1–5,000, the principal dilutions between these ranges were in the following order: 1–100, 1–200, 1–300, 1–400, 1–500, 1–800, 1–1,000, 1–1,200, 1–1,500, 1–1,800, 1–2,000, 1–2,500, 1–3,000, 1–4,000 and 1–5,000.

By observation of Table 10 it can be seen that the *Bacterium pullorum* agglutinative sera caused agglutination only when put in contact with *Bacterium pullorum*. Not the slightest agglutination occurred in any of the tubes containing test fluid other than *Bacterium pullorum*. From this data it would seem that the *Bacterium pullorum* agglutinin is highly specific, and therefore is of great diagnostic value in all work in which the organism must be determined.

Agglutinins obtained by the Immunization of Rabbits against Bacterium Pullorum.

Rabbits are easily infected with *Bacterium pullorum*, or at least show a marked reaction when injected with pure cultures of this organism; but by a careful procedure of immunization they yield very active agglutinins and also bacteriolytic sera. From 100 tests made in this laboratory it has been found that these agglutinins elaborated in this way are much more stable than those from individuals harboring the organism. Rabbits retained in this laboratory at the present time furnish sera which were active in dilutions up to 1–5,000. Agglutinins in such sera have aided greatly in the diagnosis or differentiation of cultures of *Bacterium pullorum*.

Summary.

From the work carried out at this laboratory during the summer of 1913, the following conclusions appear to be justifiable: —

1. Although the egg test for the determination of *Bacterium pullorum* may yield positive results showing ovarian infection, the elimination is

TABLE 10.

TABLE SHOWING SPECIFICITY OF BACTERIUM PULLORUM AGGLUTININ

HEN No. 85	1:100	1:200	1:300	1:400	1:500	1:800	1:1000	1:1200	1:1500	1:1800	1:2000	1:2500	1:3000	1:4000	1:5000
B. coli communis test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. coli communior test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. icteroides test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. enteritidis test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. paratyphi A test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. paratyphi B. test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. typhi abdominalis test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. fowl cholera test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. cloacae test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. lactis aerogenes test fluid + B. pullorum agglutinin															
A24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. pullorum test fluid + B. pullorum agglutinin															
A24	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
48	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
72	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-

HEN No.	1:100	1:200	1:300	1:400	1:500	1:800	1:1000	1:1200	1:1500	1:1800	1:2000	1:2500	1:3000	1:4000	1:5000
B. coli communis test fluid + B. pullorum agglutinin															
B B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. coli communior test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. icteroides test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. enteritidis test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. paratyphi A test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. paratyphi B. test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. typhi abdominalis test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. fowl cholera test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. cloacae test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. lactis aerogenes test fluid + B. pullorum agglutinin															
B24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. pullorum test fluid + B. pullorum agglutinin.															
B24	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-
48	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
72	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-

irregular and very often covers a long period of time before the organism is detected; therefore it is impractical for rapid diagnosis.

2. Preliminary incubation of the eggs in a bacteriological incubator at 38° to 39° C. prior to testing aids in the determination of the organism.

3. The macroscopic agglutination test as carried out in this laboratory, has proven a good laboratory method for the detection of adult hens harboring, or which have harbored, *Bacterium pullorum*.

4. Our work substantiates that of Jones, in that it is possible to cause a local infection of the ovarian tissue by intravenous injections of pure cultures of *Bacterium pullorum*.

5. The agglutinin is very stable, withstanding temperatures of 60° C. and over for one-half hour. If properly preserved, it will yield results after two weeks. Agglutinins have been found from infected hens which reacted positively in dilutions from 1–100 to 1–5,000.

6. Polyvalent test fluids yield more uniform results than monovalent fluids, although in birds of marked infection monovalent test fluids gave very good results. Test fluids if properly preserved on ice will keep in a very active state for more than two months.

7. Rabbits react to injections with pure cultures of *Bacterium pullorum*, but by careful immunization yield very active agglutinins and also bacteriolytic sera. Agglutinins produced by immunizing rabbits are much more stable than those from hens harboring the organism.

8. A striking pathological condition found in the ovaries of all birds was the exhibition of lobulated and retention cysts which varied greatly in size. From these, it was usually easy to isolate *B. pullorum*.

Acknowledgment. — Thanks are due my sister, Ethel G. Gage, for careful work in connection with calculation and rearrangement of the scientific data from our card-indexing system.

BULLETIN No. 149 APRIL, 1914

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

A STUDY OF VARIATION IN APPLES

By J. K. SHAW

This bulletin contains the results of a statistical study of the variation in number, size and form of the apples borne during a period of six years on several Ben Davis and Baldwin apple trees growing in the College orchard; and a consideration of the influences causing this variation.

Requests for bulletins should be addressed to the

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Amherst, Mass.

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CONTENTS.

A STUDY OF VARIATION IN APPLES.

J. K. SHAW.

Beginning with the crop of 1908 the apples borne by certain Ben Davis and Baldwin apple trees growing in the college orchard have been measured, both their transverse and longitudinal diameters being taken, and this has been continued up to and including the crop of 1913. This period includes six successive seasons in each of which the Ben Davis trees have borne at least a moderate crop, but the Baldwins have shown some irregularities in bearing. This method has given opportunity for the study of the number of apples borne, the size of the apples and the index of form. Inasmuch as the fruit of each tree has been divided into four lots by bisecting the tree with one plane perpendicular and extending east and west, and with another, horizontal, and about midway of the head of the tree, we have further the opportunity of comparing these factors for what we have called the upper south, lower south, upper north and lower north portions of the trees. Two partial reports of the observations on these trees have been made. For a statement of the method used the reader may be referred to these earlier reports.[1] The present paper reports results to date, and is probably final for this phase of the problem.

The Productiveness of the Trees.

We are not aware of any published data giving the number of apples borne by individual trees for a number of consecutive years. Several have reported the measured quantities produced over a considerable period, and these records have shown marked differences in yield of individual trees. Macoun gives the total yield for several varieties. These figures are taken from his report.[2]

Variety.	Age of Trees (Years).	Years of Bearing.	Number of Trees.	Yields (Gallons).		
				Lowest.	Highest.	Average.
Wealthy,	15	12	14	57.0	203 0	113.5
McMahon,	23	13	8	226.0	889.0	604.4
McIntosh,	21	13	2	367.5	761 0	564 0
Patten,	19	13	5	291.5	597 5	406.1

[1] Repts. Mass. Expt. Station: 22, Pt. I. (1910), p. 194; 23, Pt. I. (1911), p. 177.
[2] Rept. Central Expt. Farm., 1910-11, p. 118.

The trees on which our observations have been made are eighteen years old, and all are in a healthy, thrifty condition. All have been given the usual orchard care as to pruning and spraying; all were cared for under the cultivation and cover-crop system until August, 1911, when the Baldwin plot was seeded to grass and clover. The trees are similar in size and vigor, though there is some correlation between size and productiveness in the Ben Davis. Tree No. 8 which has produced the most apples is somewhat larger than any of the other trees. The yields of the trees for the period under observation are as follows: —

	1908.	1909.	1910.	1911.	1912.	1913.	Totals.
Tree No. 2, Ben Davis, .	864	251	425	2,453	724	830	5,547
Tree No. 3, Ben Davis, .	567	343	449	1,576	641	966	4,542
Tree No. 5, Ben Davis, .	469	155	360	1,469	354	1,264	4,071
Tree No. 7, Ben Davis, .	423	431	587	1,278	837	1,010	4,566
Tree No. 8, Ben Davis, .	–	686	1,093	2,249	629	1,611	6,268

	1908.	1909.	1910.	1911.	1912.	1913.	Totals.
Tree No. 2, Baldwin, . .	–	321	287	None.	319	None.	927
Tree No. 4, Baldwin, . .	–	621	189	1,541	None.	495	2,846
Tree No. 5, Baldwin, . .	–	319	546	253	830	None.	1,948

The differences in yield between the several trees are not as great as those reported by Macoun, especially in the Ben Davis, which is one of the most regular and abundant bearers. There is little indication of the biennial bearing habit in the Ben Davis, while the Baldwins show it clearly in later years, though they all bore a crop in both 1909 and 1910. No satisfactory reason for these annual fluctuations in crop can be assigned, but it presumably lies largely in weather conditions at the blossoming season, various conditions influencing the number of fruit buds formed during the previous season, and possibly in some degree to insects and disease. The Ben Davis has blossomed freely each year, while the Baldwins have in off years failed to blossom.

Considering for a moment the yields from the different parts of the trees, divided as has been already explained, we find some slight variations of interest. The numbers of apples have been as follows: —

	Upper South.	Lower South.	Upper North.	Lower North.
1908,	518	714	414	676
1909,	552	379	305	287
1910,	707	893	576	869
1911,	2,082	2,111	2,310	2,522
1912,	791	501	677	380
1913,	1,550	1,432	1,393	1,306
Totals,	6,200	6,030	5,675	6,040

These figures are for the Ben Davis trees only, as the Baldwins have been so irregular in bearing as to seriously interfere with any significance that the figures might otherwise have. The upper south quarters of the trees have borne the greatest number of apples, and the annual fluctuations have been least. However, the difference is not great enough to have much significance. So far as it goes it is in accordance with the reasonable supposition that that part of the tree most exposed to the warmth and light of the sun sets the largest number of fruits. As will be shown later the upper south part of the trees have yielded larger apples as well as a few more, so that the yield in barrels should be sensibly greater. If this is true of the parts of the tree, may it not indicate that a southern slope will yield more than a northern one? Probably such an assumption would be hardly justified, especially as the increased size may not hold generally. Also there have doubtless been small variations in the division of the trees from year to year, but these would tend to offset each other when the whole period is considered. Warren,[1] found in Wayne County, N. Y., the highest yields on easterly slopes, while Martin, found in Ontario County that the largest yields were from orchards on level sites followed by those on north, east and west slopes in the order given.[2]

Size.

The measurements of the greatest cross diameter seem to reveal significant differences in the size of the apples in both individual trees and different parts of the tree. Of the several Ben Davis trees No. 7 has borne the largest apples, 72.92 millimeters, and No. 3 the smallest, 69.99 millimeters; and there has been a fair degree of consistency in the sizes from year to year, No. 7 not having fallen below third place in any one year, and No. 3 having risen above fourth place only once. The other three trees have shown greater fluctuation from year to year, all having occupied both first and last places in the course of the six years of observation, and the differences in averages are not large. The few figures available for the Baldwins are greater and are consistent from year to year. Tree

[1] Cornell Bull. 226, p. 326. [2] Cornell Bull. 307, p. 107.

No. 2 has borne the largest apples and tree No. 4 the smallest, with tree No. 5 intermediate each year. The apples on tree No. 4 were much smaller in 1913 than ever before, due possibly to the previous seeding down to grass and clover.

It seems fair to conclude that individual trees may show a fairly constant tendency from year to year to produce apples larger or smaller than the general average of the orchard.

The extreme difference in average size between the individual trees amounts to a trifle less than 3 millimeters, while between the different parts of the trees it is 2.38 millimeters; but from year to year the differences are more consistent. The apples from the upper south part of the trees have been the largest every year. Those from the upper north part have been second every year except 1911, while the lower north apples have been smallest in four years out of six. This would seem to warrant the conclusion that for the variety the better the exposure of the trees to the sun the larger the growth that may be secured.

The figures for the Baldwins are too fragmentary to be of much value, but so far as they go, while not quite as consistent as those of the Ben Davis, they show the same general tendency. In 1909 the different parts were in the same order as the average of the Ben Davis, while in 1912 the upper north led, followed by the upper south, lower north and lower south.

Considering the average size of the total apples from the Ben Davis trees in the several years we note that they were largest in 1910 and smallest in 1911, the difference between the extremes being 4.04 millimeters. The small size in 1911 is undoubtedly due to the heavy crop borne, but it is significant that this is the only year in which the trees have borne enough to affect the size. There is no relation between size of apples and the number borne until the crop reaches what may be fairly termed a full crop. Probably there is more danger of breaking down the tree than of any serious deficiency in size, provided the trees are well cared for. In 1909 the apples average 90 millimeters in diameter, nearly as small as in 1911. The probable explanation of this is the low temperature prevailing, the March–October mean being the lowest of any of the six years under consideration. There are some further indications of a relationship between the warmth of the season and the size of the apples, but all the fluctuations in size cannot be thus accounted for. We have been unable to trace any relationship whatever between precipitation and size. One possible influence of fertilization is in the case of the crop of 1910, the large size of which may be due to a previous application of lime.

While there is evidence that there has been some relation between mean summer temperature and size it does not appear that the slight variations that have occurred have exercised a controlling influence on the size of the apples. In earlier work along this line a greater effect of temperature was observed, but mostly from stations further north, where seasonal fluctuations of temperature are greater.

A study of the variability in size of the apples from the different trees shows small differences that apparently have some meaning. Those from tree No. 7 are quite consistently the most variable of any, and these have been the largest; there seems to be a possible relationship between size and variability, — the larger the apples the more variable.

As between the apples from different parts of the tree, this relationship does not hold. The apples from the upper south parts of the trees are largest and least variable, and probably the slight differences in variability that occur are simply chance fluctuations.

TABLE 1.—*Size of Apples.*

Ben Davis.

INDIVIDUAL TREES.

Tree No. 2.

[Millimeters.]

YEAR.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	71.02±.14	6.16±.10	8.67±.14
1909,	70.89±.22	5.40±.16	7.62±.18
1910,	73.15±.19	5.69±.13	7.78±.15
1911,	69.15±.07	5.15±.05	7.45±.07
1912,	71.01±.18	6.68±.12	9.41±.17
1913,	75.63±.16	5.43±.09	7.18±.12
Average,	71.81	5.75	8.02

Tree No. 3.

YEAR.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	68.80±.15	5.31±.11	7.72±.16
1909,	68.48±.19	5.24±.13	7.65±.22
1910,	72.27±.19	6.01±.13	8.32±.22
1911,	69.14±.07	4.11±.05	5.94±.07
1912,	71.71±.15	5.60±.11	7.81±.15
1913,	69.54±.09	4.90±.08	7.04±.06
Average,	69.99	5.20	7.41

Tree No. 5.

YEAR.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	68.35±.13	5.55±.08	8.12±.13
1909,	68.32±.27	4.96±.18	7.26±.33
1910,	75.53±.21	5.88±.15	8.00±.22
1911,	70.16±.09	5.29±.07	7.55±.09
1912,	74.01±.25	7.08±.18	9.57±.24
1913,	71.69±.13	4.85±.07	6.76±.09
Average,	71.34	5.70	8.02

TABLE 1. — *Size of Apples* — Continued.

Tree No. 7.

[Millimeters.]

YEAR.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	72.80±.18	6.45±.13	8.86±.17
1909,	70.37±.17	5.12±.12	7.28±.19
1910,	75.12±.19	6.85±.14	9.12±.21
1911,	72.69±.11	6.11±.08	8.41±.11
1912,	72.57±.15	6.33±.10	8.72±.14
1913,	73.97±.12	5.69±.09	7.70±.12
Average,	72.92	6.09	8.35

Tree No. 8.

1909,	70.45±.13	4.93±.09	7.00±.13
1910,	72.57±.09	6.16±.06	8.52±.10
1911,	67.12±.08	5.71±.06	8.50±.09
1912,	73.39±.16	5.79±.11	7.90±.15
1913,	71.93±.09	5.48±.09	7.62±.13
Average,	71.69	5.60	7.82

PARTS OF THE TREES.

Upper South.

1908,	70.93±.18	6.40±.13	9.02±.19
1909,	70.96±.14	4.77±.10	6.72±.14
1910,	74.53±.12	4.67±.08	6.27±.11
1911,	70.79±.08	5.66±.06	8.00±.08
1912,	74.34±.13	5.41±.09	7.27±.12
1913,	73.08±.10	5.40±.07	7.39±.09
Average,	72.44	5.38	7.45

Lower South.

1908,	69.24±.14	5.68±.10	8.20±.14
1909,	69.77±.18	5.06±.12	7.24±.18
1910,	72.87±.14	6.33±.10	8.68±.14
1911,	69.86±.08	5.46±.06	7.81±.11
1912,	70.76±.22	7.28±.16	10.29±.22
1913,	71.45±.09	5.27±.07	7.38±.09
Average,	70.66	5.86	8.27

TABLE 1.—*Size of Apples*—Continued.

Upper North.

[Millimeters.]

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	71.27±.20	6.14±.15	8.47±.19
1909,	70.86±.20	5.27±.13	7.44±.19
1910,	73.94±.21	6.51±.14	8.80±.19
1911,	69.09±.08	5.65±.06	8.17±.08
1912,	72.37±.15	6.02±.11	8.31±.15
1913,	72.84±.10	5.41±.05	7.43±.09
Average,	71.73	5 83	8.10

Lower North.

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	69.79±.12	4.96±.08	7.11±.12
1909,	69.40±	5.04±	7.26±
1910,	72.32±.14	6.06±.10	8.38±.14
1911,	67.57±.07	5.55±.05	8.21±.08
1912,	70.84±.21	5.93±.15	8.37±.21
1913,	70.43±.09	5.07±.09	7.19±.08
Average,	70.06	5.43	7.75

TOTAL APPLES.

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	70.23±.08	5.95±.06	8.47±.08
1909,	70.00±.08	5.11±.06	7.30±.08
1910,	73.27±.08	6.28±.06	8.57±.08
1911,	69.23±.04	5.70±.03	8.24±.04
1912,	72.42±.08	6.31±.05	8.71±.07
1913,	73.19±.05	5.44±.03	7.44±.05

Baldwins.

INDIVIDUAL TREES.

Tree No. 2.

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1909,	78.62±.21	5.59±.15	7.11±.23
1910,	80.22±.23	5.41±.16	6.74±.27
1912,	79.20±.23	6.05±.16	7.64±.20

TABLE 1. — *Size of Apples* — Concluded.

Tree No. 4.

[Millimeters.]

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1909,	74.39±.14	5.01±.10	6.73±.15
1910,	76.90±.27	5.57±.19	7.24±.30
1911,	71.78±.08	4.58±.06	6.38±.06
1913,	66.91±.20	6.52±.15	9.74±.22

Tree No. 5.

1909,	77.66±.21	5.66±.15	7.29±.22
1910,	77 71±.15	5.20±.11	6.69±.15
1911,	78.05±.26	6.07±.18	7.78±.23
1912,	74 16±.12	5.19±.08	7.00±.11

PARTS OF THE TREES.

Upper South.

1909,	76.91±.18	5.61± 12	7.29±.16
1912,	77.50±.22	5.47±.16	7.06±.20

Lower South.

1909,	76.31±.23	5.83±.16	7.64±.21
1912,	73.02±.23	6.11±.17	8.36±.23

Upper North.

1909,	76.34±.20	5.47±.14	7.19± 19
1912,	77.96±.21	5 41±.15	6.94±.19

Lower North.

1909,	74 58±.26	5 14±.18	6.89±.25
1912,	74.86±.22	5.58±.16	7.45±.21

TOTAL APPLES.

1909,	76.29±.11	5.68±.08	7.45±.10
1910,	77.99±.11	5.55±.08	7.12±.10

Form.

The main purpose of this work has been the study of the variation in form of the apples and the causes thereof. The continuation of our observation has resulted in the accumulation of data that confirm earlier conclusions[1] and afford basis for some further deductions concerning the problem.

Ben Davis tree No. 7 which has borne the largest apples has also borne the most flattened of any, while the most elongated have been from tree No. 8 closely followed by tree No. 2. The mean indexes of form from year to year have also been fairly consistent, No. 7 ranking first four times, second once and fourth once during the six years. The other trees have been more variable, but trees Nos. 2 and 8 have shown a tendency toward elongation. As with size the differences in form are more constant in the different parts of the trees than with the different trees. The upper south apples have been the most flattened every year, but those of trees Nos. 1 and 3 from the lower north portions have been the most elongated four years out of six. The other two portions of the trees have been more variable, but the lower souths have been slightly the more flattened. As regards the standard deviation and the coefficient of variability, they do not seem to have any significance whatever; such small differences as occur are probably wholly chance fluctuations.

Turning now to the discussion of the difference in form from year to year and its relation to air temperature, which has been the main object of inquiry, we find that the paralellism between the variation and the temperature for a period following blossoming previously observed has been maintained in succeeding years. This relationship is shown in Fig. 1, which shows the fluctuations in mean daily temperature for twenty-five days following full bloom. This shows that a low temperature following blossoming is always followed by a low coefficient of form, *i.e.*, relatively elongated apple. The past season of 1913 has been the coolest of any for nearly the whole period of twenty-five days, and the apples have been the most elongated, while in 1908, 1911 and 1912, in which this period was relatively warm, the coefficient of form is much larger, *i.e.*, the apples are more flattened. In the other years both the temperatures and coefficients of form have been intermediate.

The curves of temperature, not only for the period shown in the diagram but for the entire growing season as well, have been carefully scrutinized to ascertain the critical period which determines the form of the apple. Consideration has also been given to other factors of climate, such as rainfall, humidity and sunshine, — whether they may have an effect. As a result of this inquiry there appears no evidence that factors other than that of temperature for a part or all of the twenty-five-day period have any influence. Within this period the temperature from the sixth to

[1] Mass. Expt. Station Rept.: 23, Pt. I. (1911), p. 199.

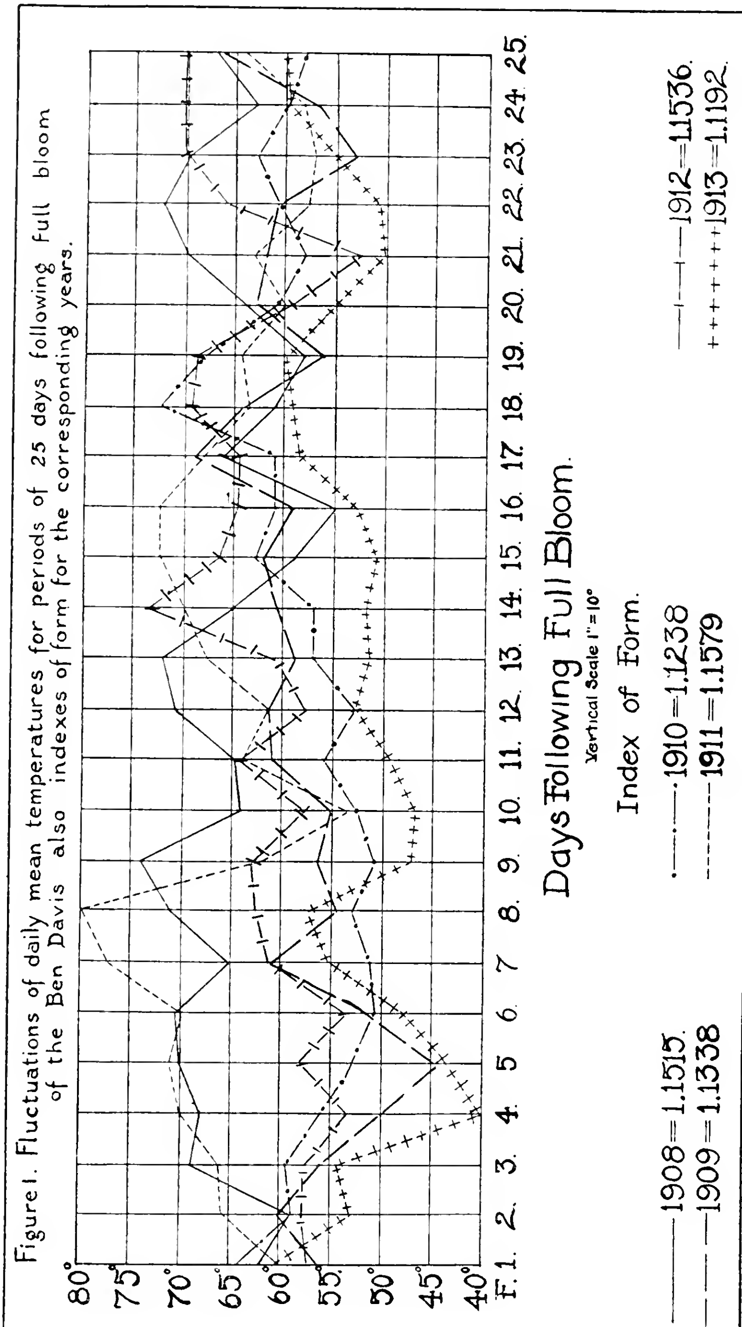

Figure 1. Fluctuations of daily mean temperatures for periods of 25 days following full bloom of the Ben Davis also indexes of form for the corresponding years.

sixteenth day seems to fit the observed fluctuations in form better than that for any other period. The relationship of the temperature for this period and the coefficient of form are as follows, the arrangement being in the order of the increase of temperature: —

Year.	Date of Full Bloom.	Temperature, Sixth to Sixteenth Day.	Coefficient of Form.
1913,	May 7,	51.24	1.1192
1910,	May 7,	54.44	1.1238
1909,	May 19,	58.19	1.1338
1912,	May 11,	62.10	1 1536
1908,	May 19,	67.63	1.1515
1911,	May 15,	67.76	1.1579

An inspection of these figures shows the general relationship, but there are some irregularities, especially in 1912 and 1908. In the latter year this period was slightly over 5° warmer than in 1912, yet the apples were more elongated. Tree No. 8 was not measured in 1908, but its apples have only once been more flattened than the average and then only slightly so. The difference between extremes of temperature for this period is 16.52° (67.76°–51.24°), and in the coefficient of form, .0387 (1.1579–1.1192). This gives an average difference of .0022 for each degree of temperature. If we calculate the relationship of the increase of the coefficient of form with that of temperature from year to year we get the following: —

Year.	Increase of Temperature.	Increase of Coefficient of Form.	
		Theoretical.	Actual.
1913,	0	0	0
1910,	3.20	.0070	.0046
1909,	6.95	.0151	.0146
1912,	10.86	.0238	.0344
1908,	15.39	.0339	.0328
1911,	16.52	.0363	.0387

Looked at from this viewpoint the only very serious difference between the actual and theoretical increases of the coefficient of form with the rise of temperature is in 1912, when it is 1.1536, whereas it should be, in order to be in harmony with other years, 1.1430. We have endeavored to account for this irregularity, but without success. Presumably some unknown factor operated to disturb the fairly close relationship observed in other years. Probably it will be necessary to attack the problem from another angle in order to understand what this may be.

TABLE 2.—*Form of Apples.*

Ben Davis.

INDIVIDUAL TREES.

Tree No. 2.

[Millimeters.]

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	1.1422±.0014	.0576±.0009	3.04±.08
1909,	1.1248±.0024	.0553±.0017	4.91±.15
1910,	1.1159±.0016	.0516±.0012	4.62±.12
1911,	1.1526±.0006	.0458±.0004	3.97±.04
1912,	1.1510±.0016	.0510±.0009	4.43±.09
1913,	1.1282±.0014	.0584±.0010	5.18±.09
Average,	1.1358	.0533	
Tree No. 3.			
1908,	1.1399±.0016	.0543±.0011	4.73±.09
1909,	1.1297±.0020	.0553±.0014	4.89±.19
1910,	1.1322±.0015	.0488±.0011	4.31±.11
1911,	1.1662±.0008	.0456±.0005	3.91±.05
1912,	1.1508±.0016	.0586±.0011	5.09±.09
1913,	1.1282±.0012	.0547±.0008	4.85±.07
Average,	1.1412	.0529	
Tree No. 5.			
1908,	1.1666±.0019	.0626±.0013	3.76±.08
1909,	1.1295±.0028	.0519±.0019	4.59±.19
1910,	1.1151±.0018	.0512±.0013	4.59±.12
1911,	1.1559±.0008	.0453±.0006	3.92±.05
1912,	1.1571±.0018	0549±.0014	4.75±.12
1913,	1.1201±.0009	.0492±.0007	4.39±.07
Average,	1.1418	.0526	
Tree No. 7.			
1908,	1.1716±.0019	.0578±.0013	3.37±.07
1909,	1.1486±.0017	.0511±.0012	4.45±.11
1910,	1.1333±.0014	.0516±.0010	4.55±.09
1911,	1.1716±.0010	.0528±.0007	4.51±.06
1912,	1.1563±.0012	.0483±.0008	4.17±.07
1913,	1.1170±.0012	.0549±.0008	4.91±.07
Average,	1.1497	.0527	

TABLE 2. — *Form of Apples* — Continued.

Tree No. 8.

[Millimeters.]

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1909,	1.1310± .0013	.0494± .0010	4.37± .09
1910,	1.1211± .0007	.0481± .0005	4.29± .05
1911,	1.1558± .0006	.0455± .0005	3.93± .04
1912,	1.1540± .0013	.0491± .0009	4.14± .08
1913,	1.1099± .0006	.0473± .0008	3.94± .07
Average,	1.1342		

PARTS OF TREES.

Upper South.

1908,	1.1643± .0017	.0593± .0012	3.61± .07
1909,	1.1390± .0015	.0520± .0011	4.57± .10
1910,	1.1299± .0013	.0500± .0009	4.43± .09
1911,	1.1610± .0004	.0486± .0005	4.19± .04
1912,	1.1557± .0012	.0505± .0009	4.37± .07
1913,	1.1283± .0009	.0513± .0006	4.55± .06
Average,	1.1464	.0523	

Lower South.

1908,	1.1512± .0015	.0619± .0011	4.19± .07
1909,	1.1302± .0018	.0516± .0012	4.57± .12
1910,	1.1249± .0011	.0489± .0009	4.35± .08
1911,	1.1614± .0009	.0468± .0005	4.03± .04
1912,	1.1609± .0014	.0461± .0010	3.97± .08
1913,	1.1156± .0007	.0416± .0005	3.73± .05
Average,	1.1407	.0496	

Upper North.

1908,	1.1553± .0020	.0607± .0014	3.91± .08
1909,	1.1333± .0020	.0509± .0014	4.40± .14
1910,	1.1216± .0016	.0544± .0010	4.85± .10
1911,	1.1598± .0004	.0470± .0005	4.05± .04
1912,	1.1430± .0013	.0487± .0009	4.26± .08
1913,	1.1241± .0010	.0527± .0007	4.34± .06
Average,	1.1395	.0527	

TABLE 2. — *Form of Apples* — Continued.

Lower North.

[Millimeters.]

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1908,	1.1406±.0016	.0644±.0011	4.58±.07
1909,	1.1338±.0021	.0529±.0015	4.67±.14
1910,	1.1171±.0012	.0505±.0008	4.52±.08
1911,	1.1511±.0006	.0454±.0004	3.95±.04
1912,	1.1537±.0018	.0505±.0012	4.37±.11
1913,	1.1065±.0009	.0529±.0007	4.78±.06
Average,	1.1338	.0528	

TOTAL APPLES.

1907,	1.1656±.0023	.0581±.0017	4.98±.14
1908,	1.1515±.0008	.0589±.0006	5.29±.05
1909,	1.1338±.0009	.0527±.0006	4.65±.06
1910,	1.1238±.0007	.0504±.0004	4.48±.04
1911,	1.1579±.0003	.0472±.0002	4.07±.02
1912,	1.1536±.0006	.0499±.0004	4.33±.04
1913,	1.1192±.0005	.0518±.0003	4.63±.08

Baldwins.

INDIVIDUAL TREES.

Tree No. 2.

1909,	1.1615±.0022	.0579±.0015	4.98±.13
1910,	1.1745±.0021	.0536±.0015	4.56±.15
1912,	1.2006±.0023	.0605±.0016	5.04±.14

Tree No. 4.

1909,	1.1848±.0014	.0523±.0010	5.41±.10
1910,	1.1834±.0027	.0553±.0019	4.67±.17
1911,	1.2342±.0008	.0469±.0006	3.80±.05
1913,	1.1962±.0024	.0774±.0017	6.47±.15

TABLE 2. — *Form of Apples* — Concluded.

Tree No. 5.

[Millimeters.[

Year.	Mean.	Standard Deviation.	Coefficient of Variability.
1909,	1.1790±.0024	.0644±.0017	5.46±.16
1910,	1.1878±.0018	.0622±.0013	5.23±.12
1911,	1.2307±.0027	.0637±.0019	5.18±.16
1912,	1.2248±.0011	.0485±.0008	3.96±.07

TOTAL APPLES.

1909,	1.1774±.11	.0583±.08	4.96±.07
1910,	1.1844±.12	.0567±.08	4.79±.07
1912,	1.2180±.10	.0502±.07	4.27±.06

SUMMARY.

1. These Ben Davis trees have borne much more heavily than the Baldwins and have shown hardly any tendency to biennial bearing.

2. Among five Ben Davis trees the most prolific tree has exceeded the least prolific by more than 60 per cent. in number of apples in the total for six crops. The Baldwins have shown even greater differences.

3. The upper south quarters of the Ben Davis trees have borne a few more apples than any of the other three quarters. This may be significant or only a chance difference.

4. Some Ben Davis trees showed a fairly constant tendency to produce apples larger or smaller than the average; others fluctuated from season to season.

5. Ben Davis apples from the upper south quarters of the trees run constantly larger than those from the other parts; those from the opposite quarters were generally smallest.

6. Only once in the case of a very heavy crop has the number of apples been large enough to affect the size.

7. There are some slight indications of a relationship between size and the average summer temperature, but the fluctuations in temperature have probably not been large enough to overcome other influences affecting size.

8. Some trees showed slight individuality in the amount of variability, and this may be correlated with size, — the larger the apples the more variable. This is not true as between the different parts of the trees.

9. As with size, some trees showed quite constant individuality in form of fruit, while others were variable. There seems to be no strong evidence that individuality in size and form are to be found in the same tree.

10. The apples from the upper south parts of the trees, which were largest, were also constantly the most flattened.

11. There is a pretty constant relationship between the form of the apple and the temperature for a period following bloom; the cooler this period the more elongated the apple.

12. An effort to delimit this period more closely indicates that the period from the sixth to the sixteenth days following full bloom fits the observed fluctuation in form more closely than any other.

BULLETIN No. 150 APRIL, 1914

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

REPORTS ON EXPERIMENTAL WORK

IN CONNECTION WITH

CRANBERRIES

By H. J. FRANKLIN and F. W. MORSE

This bulletin contains a full report on the work at the cranberry substation at Wareham for the year 1913, by H. J. Franklin, and a report on the results of the study of the water of the artificial cranberry bogs in Amherst, by F. W. Morse.

Dr. Franklin's report presents conclusions on many important points, among which some of the more prominent are frost protection, prevention of fungous diseases, effects of fertilizers, destruction of injurious insects with especial reference to flowed-bog fire worm and the fruit worm, insect parasites, weed destruction and resanding.

Professor Morse presents the results of numerous analyses of bog water, and shows that up to the present time there seems to be no direct relation between varying applications of fertilizers and the composition of the drainage water. His work shows a direct relation between free circulation of water and drainage and vine growth.

Requests for bulletins should be addressed to the

Agricultural Experiment Station,

Amherst, Mass.

Massachusetts Agricultural Experiment Station.

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CONTENTS.

REPORTS ON EXPERIMENTAL WORK IN CONNECTION WITH CRANBERRIES.

H. J. FRANKLIN AND F. W. MORSE.

REPORT OF CRANBERRY SUBSTATION FOR 1913.[1]

The year's experiments and observations may be discussed under the ten following heads: weather observations, frost protection, fungous diseases, varieties, blossom pollination, fertilizers, insects, weeds, resanding and miscellaneous.

1. WEATHER OBSERVATIONS.

Blanks have been prepared for recording on a single sheet all the more important phenomena observed in connection with every frosty night during the cranberry growing season. On these blanks space has been left for recording the minimum temperatures at 15 stations (bogs) besides that at the station bog. It is also planned to note in this record the amount of injury (estimated) on the Cape and in New Jersey caused by each severe frost. It is hoped that the mass of data condensed in such records will make it possible to better understand the Cape frost weather conditions and to make more satisfactory frost predictions as a result. Only a few of the temperature observing stations planned for have, as yet, been established, but it is hoped that another season will see all the thermometers properly placed for taking a fairly representative lot of minimum temperature observations for the entire Cape. The barometric changes and their influence on frost conditions, both as indicated by the weather map and as shown by the action of the barometer itself, have been carefully studied, with some interesting results. The high barometric waves appear, as a rule, to be most dangerous when they extend both far to the North and far to the South, without any low wave on the Atlantic seaboard to the south of us. One of the great uncertainties about the barometric action, as far as the weather map is concerned, seems to be caused by the occasional more rapid deepening of a low wave in or around the lower St. Lawrence valley, than is offset by the advance of the high wave, the general result being a fall of the barometer in an important

[1] By H. J. Franklin.

section where a rise would, as a rule, be expected. This fall of the barometer in the northeast often causes the wind to keep up all night when other conditions would lead a forecaster to expect almost a dead calm. There seems to be no way of figuring on this action of the barometric waves, except by more extensive observations of conditions in the eastern Provinces of Canada than are at present carried out by the Weather Bureau. The officials of the Weather Bureau are planning to take special afternoon barometric observations in that section, in order to forecast our frost conditions more accurately.

Another puzzling factor is the occasional occurrence of cloudiness on mornings when, from the general weather conditions, no cloudiness would naturally be expected. It seems quite possible that we may not be able to fully understand the causes of such cloudiness without a study of the conditions of the upper atmosphere. This is of course a very important matter, for the presence of clouds always makes a difference of several degrees in the temperature of a cold night.

The readings of the maximum and minimum shelter and bog thermometers, and the amounts of precipitation, were telegraphed to the office of the United States Weather Bureau at Boston, every morning after May 4, during the spring and fall periods of frost danger. Triple register (for sunshine, wind direction and wind velocity), thermograph, and barograph records were taken in the usual way throughout the season, from early May until the last of October. As the hydrograph did not work satisfactorily no records were made with that instrument.

There seems to have been this year a general increase in confidence, on the part of the growers, in the forecasts sent out from the Boston office of the Weather Bureau. This increased confidence is probably fully justified, for the forecasts seem to have been much more accurate during the past season than formerly.

2. FROST PROTECTION.

Careful consideration has been given to the different possible methods of frost protection where water is not available for use in the usual way.

It was suggested in last year's report that it might be possible to use the Skinner system, or some other sprinkling arrangement, with an engine and pump only large enough to pump water for one section at a time, the idea being to draw the frost out of the vines by one or two applications of cold water in the morning, before they were thawed out by the heat of the sun. The practicability of this method was tried out on a small scale last May with a spraying outfit, and the results seemed to be far from satisfactory, for the sprayed areas afterward appeared to show distinctly more injury than did the surrounding unsprayed portions of the bog. As the whole matter now stands, therefore, it does not seem at all probable that the Skinner system can very well ever be made practical use of for frost protection. Its undesirability from the standpoints of expense and nozzle clogging were discussed in last year's report. All other

sprinkling systems at present on the market are even more expensive, and will probably, on this account, never be practically available for this purpose.

As indicated in last year's report, the expense connected with the use of orchard heaters is prohibitive, to say nothing of the danger from fire, and of the injury to the vines which would unavoidably be done by the spilling of oil.

There are many other possible methods of frost protection for cranberry bogs which have not yet been tried. It may be possible to cause the frost to be drawn out slowly from the vines after a frost by screening the bog from the sun during the first two or three hours of the morning, perhaps by a curtain of smoke. This method is suggested by the well-known fact that the greater part of the injury, caused by freezing in both plant and animal tissues, is usually due more to the sudden withdrawal of the frost in the process of thawing than to the formation of the frost in them.

The possibility of protecting a bog from frost by covering it over with cloth is of course generally recognized. Though this would be an expensive protection, it has the probable advantage of being entirely effective. It is, however, probably unwise to attempt any special frost protection on dry bogs because of the peculiar conditions and difficulties otherwise associated with such bogs. The only kind of bogs, the general conditions of which probably warrant special protection, are those which are winter-flowed but cannot be reflowed to any extent.

As a rule, the managers and owners of most of the Cape bogs, which have poor frost protection, seem to have overlooked the method of protection, which, though not perfect, is, nevertheless, many times very effective, and which can be applied with a relatively small cost, namely, that of keeping the bog well sanded. It has been shown by the experiments carried out by Prof. H. J. Cox for the United States Weather Bureau and by the Wisconsin Station that there is a protection against several degrees of frost to be had by this use of sand. Many of the Cape growers have come to realize this from general experience, and striking examples of the efficiency of this protection are not infrequently seen. It seems certain that a very considerable percentage of the Cape cranberry losses from frost, incurred where water protection is not available, could be saved by a more general understanding and application of this principle of re-sanding for protection.

3. FUNGOUS DISEASES.

The arrangement by which this work has heretofore been carried on in co-operation with the Bureau of Plant Industry of the United States Department of Agriculture has been continued this year. Dr. Shear has had general supervision of the spraying experiments as heretofore and has conducted the laboratory investigations. A considerable number of spraying tests were carried on by the growers, especially in Wareham and in and about Harwich, the results of some of which have not as yet

been received. The five plots, each four rods square, which were sprayed in 1911 and 1912 as indicated in previous reports, were all sprayed again this season with Bordeaux mixture used in the same way as last year (3 pounds of lime, 4 pounds of copper sulphate and 2 pounds of resin fish oil soap to 50 gallons of water), but a greater number of times, plots A and C (Lake Howe plots) being sprayed with the Bordeaux on June 5, June 17, June 28 and July 19, and with neutral copper acetate (1 pound to 50 gallons of water) on August 7. Plot B (the McFarlin plot) was sprayed with Bordeaux mixture on June 6, June 18 and July 21. Plots D and E (the Early Black plots) were sprayed with Bordeaux mixture on June 6, June 18, July 11 and July 22. The crop was gathered from these plots and their checks on dates and in amounts as follows, the quantities being given in bushels: —

TABLE 1.

PLOT.	Area (Square Rods).	Date when picked.	Variety.	Quantity of Fruit (Bushels).	Quantity per Square Rod (Bushels).	Average of Double Checks per Square Rod.	Per Cent. of Decrease on Sprayed Plots.
A, ...	16	Sept. 24	Howe.	$8\frac{1}{6}$	.5100	-	74
A (check 1), .	4	Sept. 25	Howe.	$4\frac{1}{15}$	1.0170	1.942	-
A (check 2), .	9	Sept. 25	Howe.	$25\frac{4}{5}$	2.8660		
B, ...	$14\frac{1}{8}$	Sept. 25	McFarlin.	$13\frac{1}{4}$	.9380	-	49
B (check), . .	$13\frac{2}{3}$	Sept. 25	McFarlin.	25	1.8300	-	-
C, ...	16	Sept. 24	Howe.	9	.5625	-	53
C (check 1), .	4	Sept. 24	Howe.	5	1.2500	1.198	-
C (check 2), .	8	Sept. 24	Howe.	$9\frac{1}{6}$	1.1460		
D, ...	16	Sept. 17	Early Black.	$19\frac{2}{3}$	1.2300	-	45
D (check 1), .	3	Sept. 17	Early Black.	$6\frac{2}{5}$	2.1330	2.240	-
D (check 2), .	9	Sept. 24	Early Black.	$21\frac{1}{9}$	2.3460		
E, ...	16	Sept. 3	Early Black.	$21\frac{1}{2}$	1.3440	-	26+
E (check 1), .	8	Sept. 3	Early Black.	15	1.8750		
E (check 2), .	4	Sept. 3	Early Black.	$6\frac{1}{2}$	1.6250	1.830	-
E (check 3), .	4	Sept. 3	Early Black.	8	2.0000		

It will be seen from this table that there was a general very marked falling off in the fruit produced by these sprayed plots as compared with the surrounding untreated portions of the bog. Where two checks were laid out for the same plot (as noted in the table), they were in every case located on different sides of the sprayed area. The berries were all picked with scoops. The spraying was done with a 30-gallon wheeled-barrel outfit, as heretofore, but the mechanical injury done in the process of spraying was not very great, as a long hose was used, and the outfit was in

no case taken onto either the sprayed areas or their checks. The general result of this spraying is interesting in the light of the observations made in connection with the Early Black and McFarlin plots in the late fall of 1912. At that time it was noticed that these plots seemed to have foliage of a much lighter and more sickly appearance than was shown by the vines of their checks. As noted in last year's report, this contrast was very marked and led to the suspicion that, on account of the evidently unthrifty condition of the sprayed areas, they would not, in the season of 1913, produce as good a crop as their checks. The situation suggests that there was not sufficient available plant food present for the sprayed vines, while they were producing the 1912 crop, to maintain a strong vine condition and at the same time develop the extra amount of fruit which the reduction of fungous diseases, caused by the spraying, had made possible. Whether this was the real cause for the decreased fruiting of these plots, or whether the spraying had done the bog injury in some unknown way, it is, as yet, impossible to state with certainty. It should be noted in this connection that in the fall of 1913 the vines of all these plots showed an even more marked unthrifty and sickly appearance in comparison with their checks than they did in the fall of 1912, though they had not, as shown in the table, produced nearly as large crops as the checks. The Howe plots (A and C), which did not show in 1912 any marked effect on the vines, in the fall of 1913 were so red all over (except the fertilized middle portion of plot A) as to give the impression, to one viewing the bog from a distance, that the fireworm had been working severely on them. This would seem to indicate that the spraying had in some way caused a cumulative injury.

On June 28, the middle half of plot A (one of the Howe plots) was fertilized, a quarter of the plot on each side being left without fertilizer, the fertilizer being used on the middle portion at the following rate: nitrate of soda, 200 pounds per acre; acid phosphate, 400 pounds per acre; high-grade sulphate of potash, 200 pounds per acre. This fertilized middle half (8 square rods) of the plot produced 5 1/12 bushels of berries, while the unfertilized side strips (the area of each being 4 square rods) produced, respectively, 1 1/12 bushels and 2 bushels. It will be seen from these figures that there was a very marked increase of fruit on the middle portion, due to the application of the fertilizer. This is particularly interesting because, at the time when the fertilizer was applied, the vines were going out of bloom, and there was no rain to speak of, to dissolve the fertilizer and wash it into the soil, for several days after the application. It is the first time in our experience that fertilizers have been known to cause a marked increase in the amount of fruit on a cranberry bog in the first season applied. This is suggestive in several ways. It looks as though vines which have borne a larger crop, due to freedom from fungous disease brought about by spraying, need an extra supply of plant food the following year in order to maintain their vigor and hold their own in fruiting with unsprayed vines. The results of this fertilizing

and spraying may perhaps also be taken to indicate that fertilizers will do their best work in driving fruit production only when the vines are comparatively free from fungous disease. They also suggest the possibility that there is a best time for applying fertilizers, in order to get the best fruiting, perhaps at about the blossoming period. A rather marked increase in fruit production, following a first application of fertilizers rich in nitrates, during the blossoming period, on Howe vines, was noted on some other bogs toward the close of the season. There seems to be much yet to be learned along these lines by further experimenting.

An unexpected result of the spraying, noticed on all five of our old fungous plots during the season, was the killing of the wood moss. This moss appears to have been completely killed out on every one of these plots, while, on the general bog surrounding some of them, it is present in considerable abundance and very much alive up to the very edge of the plot.

When the fruit was gathered from these five plots, no marked difference in color between the berries from the sprayed plots and their checks was observed. The size of the berries from the Early Black and McFarlin plots was practically the same as that of the berries from the checks, but the berries from plots A and C (Howe plots) were distinctly smaller than those from their checks, as shown by the following averages of counts of berries in cupful samples (New England Cranberry Sales Company's inspector's cup) from the different plots and their checks, the samples being in each case taken as evenly as possible from the various boxes: —

TABLE 2.

PLOT.	Number of Samples counted.	Average Number of Berries per Sample.	Variety.
A (fertilized middle portion),	8	96	Howe.
A (the unfertilized side portions),	4	97	Howe.
A (check),	8	90	Howe.
B,	8	60	McFarlin.
B (check),	8	61	McFarlin.
C,	8	102	Howe.
C (check),	8	96	Howe.
D,	6	113	Early Black.
D (check 1),	4	110	Early Black.
D (check 2),	6	108	Early Black.
E,	6	109	Early Black.
E (check),	6	109	Early Black.

The keeping qualities of the berries from these five old fungous plots and their checks were tested, with the results shown in the following table: —

TABLE 3.

PLOT.	Date picked.	Test begun.	Test ended.	Quantity tested (Boxes).	Quantity of Sound Fruit after screening (Boxes).	Percentage of Loss.	Variety.
A (fertilized middle portion).	Sept. 24	Oct. 28	Dec. 19	4	3⅜	15⅖	Howe.
A (unfertilized side portions).	Sept. 24	Oct. 28	Dec. 19	2	1⅔	17⅔	Howe.
A (check), . .	Sept. 24	Oct. 28	Dec. 20	4	3 1/14	23⅙	Howe.
B, ...	Sept. 25	Oct. 28	Dec. 23	4	3 1/13	23	McFarlin.
B (check), . .	Sept. 25	Oct. 28	Dec. 23	4	3	23	McFarlin.
C, ...	Sept. 24	Oct. 28	Dec. 19	4	3⅝	10 3/10	Howe.
C (check), . .	Sept. 24	Oct. 28	Dec. 19	4	3 1/7	21⅓	Howe.
D, ...	Sept. 17	Oct. 28	Dec. 22	3	2 1/11	30⅖	Early Black.
D (check 1), . .	Sept. 17	Oct. 28	Dec. 20	2	1¼	38¼	Early Black.
D (check 2), . .	Sept. 24	Oct. 28	Dec. 23	3	1⅔	44⅛	Early Black.
E, ...	Sept. 3	Oct. 28	Dec. 17	3	2½	17⅔	Early Black.
E (check), . .	Sept. 3	Oct. 28	Dec. 17	3	2⅛	29⅖	Early Black.

The boxes used in measuring for these tests, as well as for all other keeping tests conducted during the season, measured 19¼ inches by 14½ inches by 8½ inches, and no considerable error was allowed to creep into the measurement of the fruit on account of variation in the dimensions of the boxes. The fractions given in the above table are only approximate, it being considered that absolute accuracy is not of sufficient importance to call for the including of large numbered fractions. In all the season's storage tests the berries were stored without screening or hoppering. When they were picked, the vines were cleaned out from the boxes by hand as carefully as possible, so that there might be uniformity among the boxes in the quantity of vines they contained. When measured for storage (on October 28 and 29), the boxes were carefully shaken and filled level full, and after screening the berries were again thoroughly shaken before they were measured.

Judging from the figures, concerning the berries from plots D and E given in Table 3, it might be thought that these tests showed a superior keeping quality for early picked berries. While it is not, of course, impossible that this factor may have entered into the results of the tests, it should be borne in mind that the two plots in question are located on the bog at a considerable distance from each other, and there is always more or less variation in the berries of the same variety harvested from the different portions of the bog. Supporting this fact is the fact that last year the berries from plot D kept better than did those from plot E, the reverse of the results obtained by our keeping tests this year.

The results of the tests of the keeping qualities of the berries of the McFarlin plot and its check are remarkable in that they appear to indicate absolutely no effect resulting from the spraying, a result never before even nearly approximated in any test of berries, which had been sprayed with Bordeaux mixture, carried out at the station bog. It should be noted in this connection that the McFarlin berries, both sprayed and unsprayed, on the station bog, and apparently also on other bogs in its vicinity, kept unusually well this year, apparently as a natural result of the peculiar weather conditions.

Three new fungous plots were this season started on the station bog. One of these (on Howe vines) was sprayed with lime-sulphur solution, made from Frost's Powdered Lime-Sulphur, on June 7, June 18, June 28, July 21 and August 7. This plot was picked on September 28. Its area is 9 square rods, and it yielded 5 1/3 bushels, while a check of 6 rods immediately adjacent yielded 12 2/3 bushels. The marked decrease on the sprayed area was probably due to some injury caused by the spray. The berries from this plot and its check were tested for keeping quality, the results being in favor of the check, the percentage of loss among the berries of the plot being 34 1/2, while amongst those of the check it was only 25 1/2. As far as the results obtained from this plot are concerned, therefore, there seems to be nothing to be said in favor of this preparation for use as a cranberry fungicide. It is planned to continue this test another season.

Another of the new plots was sprayed with Bordeaux mixture, prepared in the usual way, on June 7, June 17, June 28 and July 21, and with neutral copper acetate on August 7. The area of this plot is 9 square rods and it yielded 7 1/3 bushels, while its check of equal area yielded 12 bushels. In the storage tests the loss among the berries from this plot was approximately 17 per cent., while its check showed a loss of 27 1/5 per cent.

One-half of the fertilizer plot which had, previous to 1913, been treated the most heavily with nitrate of soda, was also sprayed during the season, for the first time, for the purpose of learning about the combined results of fertilizing and fungous spraying. The spraying with Bordeaux mixture was done on June 6, June 17, July 11 and July 21, and neutral copper acetate was used on August 7. The whole fertilizer plot (plot 15) was picked on September 16, and the sprayed portion yielded only 3 1/2 bushels, while the unsprayed portion gave approximately 6 1/3 bushels. In the keeping tests, begun with these berries on October 28 and ended on December 22, the sprayed berries showed a loss of only 31 2/5 per cent., while the unsprayed lost 44 3/5 per cent.

It will be seen from the figures here given that there was a marked decrease in the fruit production on both of the two new plots treated with Bordeaux mixture and neutral copper acetate. This is in accord with the results generally obtained in the co-operative spraying tests carried on on other bogs by the growers during the season, at least in those tests in which spraying was done during the blooming period. While it is impos-

sible to say definitely what caused the falling off in the fruiting on the sprayed areas, it seems highly probable that the Bordeaux mixture was in some way injurious when used during the blooming period. This can be determined only by further tests.

The new disease, spoken of as the "blossom end rot" in last year's report, was much in evidence, after picking, among the Howe berries of the station bog again this year, most of the rot among those berries being evidently due to it. During the month of October, samples of Howe berries were collected from 54 different bogs, for the purpose of gaining some knowledge concerning the distribution and severity of this disease on different parts of the Cape, as such knowledge seemed not only desirable from the scientific standpoint but also more or less essential for practical purposes. The bogs from which these samples came were distributed as follows: Chatham, 2; Harwich, 4; Mashpee, 1; Falmouth, 1; Nantucket, 1; Wareham, 16; Carver, 7; Marion, 2; Rochester, 2; Plymouth, 3; Middleborough, 2; Pembroke, 2; Hanson (including Bryantville and South Hanson), 11.

The "blossom end rot" was found to be present in varying amount in all the samples collected, and the examinations (made from December 11 to December 15, inclusive) appeared to produce no certain evidence that there is any very distinct sectional variation in the degree of its prevalence among the different portions of the Cape. The largest percentage of loss found to have been certainly caused by this disease, at the time of examination, in any of these collected samples, was roughly $8\frac{1}{2}$ per cent., and the smallest loss found in any sample was roughly $1\frac{1}{3}$ per cent. Much of the rot present, however, which did not show the characteristics of this disease definitely was probably, nevertheless, caused by it.

Experiments with Copper Sulphate in the Flowage.

In June, tests were begun looking for the control of fungous diseases on cranberry bogs by the application of copper sulphate in the flowage. These tests were carried out on the flooding sections of the station bog. The strengths of the copper sulphate tried were 1 part to 50,000 parts of water (1 pound in 6,250 gallons) on sections 23 and 25 and 1 part to 100,000 parts of water (about 1 pound in 12,500 gallons) on section 27. The copper sulphate was first dissolved in pails of water, and the solutions were distributed as evenly as possible in the flowage of these sections by throwing them into the flowage by the cupful. This treatment was applied to these sections on June 3 and again on June 16.

On section 23, each treatment was continued about twenty-three hours, the chemical being applied to the flowage within an hour or two after the section was completely flooded. As the whole bog was flooded at the same time that the flooding sections were flowed for this treatment, the vines were more or less wet for several hours before the copper sulphate was put in the water.

On section 25 the treatment was continued for eleven hours and was applied after twelve and one-half hours of complete flooding without treatment.

On section 27 the duration of the treatment was about eleven hours and as with section 25 followed twelve and one-half hours of complete flooding without treatment.

When the first treatment was applied to these sections the blossom buds were well developed and prominent, and when the second treatment was applied they were approaching near to blooming, there being here and there a blossom already opened. The treatment did not appear to affect the buds on sections 25 and 27 injuriously in any way. Some of those on section 23, however, were spotted slightly, showing that the solution used had probably been fully as strong as was desirable.

The strength of the solution used on section 23 was recommended to me by Dr. Shear, as the result of laboratory experiments which he had conducted. Unfortunately, spanworms worked seriously on section 23 and reduced the crop to such an extent as to destroy the results of the experiment so far as the amount of the fruit might give any evidence concerning the effect of the treatment.

At picking time sections 25 and 27 yielded fruit at approximately the same rate as the untreated flooding sections immediately adjacent, while section 23 showed a marked falling off. These sections were picked on September 2.

The berries from all the flooding sections were tested for keeping quality, the period of storage extending from October 29 to December 17. The treated sections 25 and 27 showed little if any improvement over the untreated sections. The berries from section 23 seemed to keep better than those from the other flooding sections, but the difference was not sufficiently marked to justify the conclusion that the copper sulphate treatment had been decidedly beneficial.

4. VARIETIES.

Investigations looking toward the possible development of more desirable and more prolific varieties were continued, especially prolific vines of the late Howe and Vose's Bell varieties being marked for observation next season. Some interesting and apparently valuable sports of the Late Howe variety were also found and were marked. Unfortunately, the majority of the uprights, marked in previous years on account of their prolificness, did not bear well in 1913, though there were a few exceptions.

Samples of the berries of most of the different varieties grown on the Cape were collected in October. Samples of vines were also collected where it was possible to get them without too much trouble. Later these samples were studied more or less carefully, and the varieties which appeared to be mixtures of two or more distinct varieties were separated in a general way into their component parts. From these collected samples smaller samples, numbering in all 180, were taken and bottled in alcohol

and formalin for future study and reference. The following are the varieties which were thus sampled, together with the number and general location of the bogs from which samples of each were taken: —

TABLE 4.

VARIETY.	Number of Bogs from which Samples were taken.	General Location of these Bogs.
Early Black,	1	East Wareham.
Late Howe,	1	East Wareham.
Early Red,	2	Wareham (East and West).
Early Red (?),	1	East Wareham.
Centerville,	2	South Carver and East Wareham.
Perry Red,	1	Marion.
Matthew,	8	East Wareham, Pleasant Lake, Bryantville and South Chatham.
Jersey Berry,	1	West Wareham.
Centennial,	3	Carver.
Champion,	1	Carver.
Mammoth,	2	Bryantville.
Bugle,	5	Santuit, Carver, Bryantville and East Wareham.
Horseneck,	1	Marion.
Berry Berry,	2	Wareham.
Samuel Small's Bugles,	1	Harwich.
McKinley (or Berlin),	1	Chatham.
Cherry Berry,	1	Plymouth.
McFarlin,	5	Carver and East Wareham.
"Howe,"	1	Wareham.
"Howe,"	1	East Wareham.
"Howe,"	1	East Wareham.
Carver Red,	1	Marion.
Unknown Variety,	1	Mashpee.
Vose's Bell (or Pride),	1	Marion.
Shaw's Success,	2	Carver.
Reds,	1	Bryantville.
Smalley's No. 1,	1	East Wareham.
Smalley Berries,	2	South Harwich and East Wareham.
Hocanun,	1	South Hanson.
Aviator,	1	Carver.
North Cape Howe,	1	Wareham.
Leonard Robbins' Berry,	1	Harwich.
Atkins' Seedling,	4	Brewster, Harwich and Plymouth.

Several of the less well known of these varieties, judging from the appearance and condition of the samples when they were examined in January and from the notes obtained when the collection was made, appear to have highly commendable qualities and would probably give a good account of themselves if they were more extensively planted.

5. BLOSSOM POLLINATION.

The plots, from which bees were screened out on the station bog during the blossoming periods of 1911 and 1912, yielded fruit in 1913 at approximately the same rate as the surrounding bog. A new plot was screened off during the 1913 blossoming period with wire netting through which no bee could work its way. There were a few blossoms present when the screen was put in place, but these were all carefully picked off. The crop on this plot was picked on October 8 and amounted to 2¾ quarts, the area of the plot being approximately half a square rod, while the crop produced on any equal area of the surrounding bog was not less than a bushel. It will be noted that this result was in accord with the general results obtained in all similar previous experiments, except that the results with last year's plot were not nearly so striking.

As it was evident at a glance that the margins of the 1913 plot were bearing more berries than its central portion, a margin 9 inches wide was marked off around the plot and picked separately. The total area of this margin was approximately 34 square feet, slightly more than one-fourth of the entire area in the plot, yet it yielded 664 berries, while the whole plot produced only 1,452. A further marked peculiarity noted was that the portion of this margin lying on the upland side of the plot bore much more heavily than did the remainder, the plot being located at the edge of the bog, just across the ditch from the upland.

While these observations seem suggestive, it does not seem that any definite conclusion can be drawn from them.

6. FERTILIZERS.

The station bog plots used in the 1911 and 1912 fertilizer tests were again treated in 1913 with the same kinds and quantities of fertilizer as before. Because of reflowing operations just before the bloom, the fertilizers were applied later than usual, — on July 15. At picking time it was found that the fertilized plots had not, as a rule, produced as many berries as the check plots, the reverse of the result obtained last year. The decrease on the fertilized plots was not very marked, however, except with plots 14 and 15, these being the two plots on which nitrate of soda had been used in the largest quantities. Plot 15 showed a much greater falling off than did 14, and it had received heavier applications of the nitrate than had 14. This result is somewhat surprising in view of the fact that these two plots had by far the heaviest blossom of any portion of the bog. For some reason, however, there was a marked drying up of the blossoms and small berries on these plots, especially on plot 15, not

observed to any such extent on other portions of the bog. The conditions were such that, all things considered, this drying up could not very well be laid to dry weather. The reduced fruiting seems to have been due to a detrimental effect of the nitrate, though it is perhaps impossible to say with certainty just what the effect was.

It must be remembered that half of plot 15 was this year sprayed for fungous diseases as well as fertilized, but the unsprayed portion showed a marked falling off in the quantity of fruit as well as the sprayed portion, though the reduction was not so great on the unsprayed part.

All the fertilizer plots were picked with scoops on September 15 and 16. The berries appeared so uniform in color and most other respects that no records were made except those concerning their quantity and size. The average counts of berries in several cup samples taken from each of the plots did not show any considerable differences in size that could apparently possibly be considered to have been caused by the fertilizer.

Storage tests were carried out with berries from all the plots, beginning on October 28 and 29 and ending December 17 to 23, the results of which did not appear to show any marked effect on the keeping quality, attributable to the use of the fertilizers, except with the berries from plot 15. The berries from this plot showed poor keeping quality, due apparently to the excessive use of nitrate of soda. It will be remembered, in this connection, that this plot has received heavier applications of the nitrate than have any of the others.

7. INSECTS.

This year saw a marked decrease in the prevalence of both the flowed-bog fireworm (black head cranberry worm) and the fruit worm. Last year the injury done by both of these insects was abnormally severe as compared with that of most of our recent seasons. This year, however, both insects caused comparatively little trouble, a surprising fact, considering the damage done by them last year. The causes of this year's reduction of these two pests are obscure, but it seems possible that some condition of the weather during some period of the year was responsible for it. If so, the most marked peculiarity noted in these conditions was the very open winter of 1912–13, especially during December and January. Probably the only way in which we can come to any definite conclusion concerning the bearing of weather conditions on the prevalence of these insects is to keep a careful record for a long period of years, and make comparisons of the experiences of one year with those of another.

The season of 1913 has had other peculiarities from the standpoint of cranberry insect troubles, especially in an unusual prevalence of cutworms and of spanworms of several different species. During the season numerous reports came in from cranberry growers, telling of threatening gypsy moth trouble, and the little cranberry snout beetle seemed to be more troublesome than usual.

On August 15, 1912, 42 pupæ of the spanworm, spoken of in last year's report as having done serious damage on the Old Colony bog at Yarmouth, were collected. They were kept on moist sand in cans through the fall, winter and spring. Between June 6 and 15, 33 moths emerged from these pupæ, but no parasites were obtained from them. Three of the pupæ which failed to produce moths appeared to be in good condition and were probably killed by overheating a few days before the moths would have emerged. Of the 33 which emerged, 17 were females and 16 were males. These moths were protandrous in emerging, for before June 11, 13 males and only 8 females emerged, while after June 10, 9 females and only 3 males emerged.

The Old Colony bog was visited on June 13, and the moths of this insect were found to be present in great numbers on an area of about 2 acres (estimated) which had not been treated in any way to get rid of the insect because that portion of the bog belonged to a separate and apparently careless owner. It was estimated that three-fourths of the moths present were males, though the proportions of the sexes were not carefully ascertained. Portions of the bog, which had been heavily infested in July and August, 1912, had been burned over in the latter half of August, and other infested portions had been resanded with seven-eighths to one and one-half inches of sand. Practically no moths of the spanworm were found on June 13 on any of these treated portions, except where the treated areas immediately adjoined untreated heavily infested areas. Evidently the burning had effectively destroyed the pupæ and the sanding had smothered them.

It should be noted that, though the bog had been completely under water for over four months, the winter flowage had not drowned any considerable percentage of the pupæ. This seems remarkable, for they were entirely naked (*i.e.*, were without any cocoon), and they lay fully exposed on the surface of the sand. Practically all of these pupæ found on the bog on June 13 showed distinct signs of life when they were picked up.

At the time of the visit to this bog (June 13) the millers on the infested portion were being caught and eaten (the males mostly, as this sex flew up into the air readily, sometimes as high as 25 or 30 feet, while the females, as a rule, being heavy with eggs and unable to fly well, stumbled and flopped along the ground when attempting to do so) by swallows (two barn swallows and a dozen or more tree swallows). These swallows were flying back and forth like bats, and the clicking of their bills was incessant as they captured the moths.

On June 15 the eggs were dissected out of several plump female moths and counted. These eggs were all bright green in color when fresh from the moth, but they afterward turned yellowish. They numbered 295 in the most productive moth and 187 in the least productive one. Eggs of this insect were found hatching in the laboratory on June 19 and 20.

On July 8 the Old Colony bog was visited again, and the following notes

concerning this insect were obtained from Mr. Ellis, the foreman of the bog, who seemed to be a very good observer: —

> The first worms of this insect were found on the bog on June 25. They were then very small. Unhatched eggs were also present in abundance on June 25. Small worms were seen in numbers spinning down the vines and hanging by small silken threads. Most of the moths had disappeared by June 18. The eggs on the vines were yellow and laid in scattering small batches (three to five together). The worms worked first on the backs of the leaves. On June 15 the female moths were more numerous and were scattered more widely over the bog than they were on the 13th, but the males were much less numerous on the 15th than they had been on the 13th. Females full of eggs were abundant on the 15th.

Mr. Ellis had been spraying a considerable part of the portion of the bog that was under his management, and his experience seemed to show that it is not very difficult to control this insect by thorough spraying with arsenate of lead.

On July 8 the worms (of many different sizes) were present on the badly infested portions of the bog in great numbers, the vines having been turned brown by their work and when opened appearing literally alive with them. So little foliage was left on the worst infested portions of the bog that death by starvation for a very large percentage of the worms seemed inevitable.

This insect was also found to be threatening a bog in Mattapoisett this year. Its scientific name is *Epelis truncataria* var. *faxonii* Minot. It has also been found feeding on the bearberry (*Arctostaphylos uva-ursi* L.).

A considerable number of parasites have been reared from the various cranberry pests, the names of which have not yet been determined. Some of these forms appear to represent species new to science. The species which have been named are listed in the following table: —

TABLE 5.

SCIENTIFIC NAME OF HOST.	Common Name of Host Insect.	Scientific Name of Parasite.	Order to which Parasite belongs.	Name of Expert who determined the Name of the Parasite.	Date of Emergence of the Parasite.	Number of Specimens obtained.	Stage of Host's Life-History from which reared.
1. *Peronea minuta* (Rob.),	Dry-bog fireworm,	*Exorista pyste* Walk.,	Diptera,	C. W. Johnson,	September 1 to 10.	10	Pupa.
		Phytodictus vulgaris Cress.,	Hymenoptera,	H. L. Viereck,	August 24, 1906.	1	-
		Pimpla conquisitor (Say.),	Hymenoptera,	H. L. Viereck,	- -	1	-
2. *Mineola vaccinii* (Riley),	Fruit worm,	*Phanerotoma tibialis* (Hald.),	Hymenoptera,	H. L. Viereck,	July 1 to 15.	Very many.	Larva.
		Microbracon dorsator (Say.),	Hymenoptera,	H. L. Viereck,	July 2, 1907.	1	-
3. *Cymatophora sulphurea* Packard,	Spanworm,	*Ichneumon extrematatis* Cress.,	Hymenoptera,	H. L. Viereck,	- -	1	-
		Euphorocera claripennis Macq.,	Diptera,	C. W. Johnson	- -	1	-
4. *Calocampa nupera* Lintner,	False army worm,	*Winthemia quadripustulata* F.,	Diptera,	C. W. Johnson,	July 23, 1906.	1	Pupa.
5.	Bud worm,	*Tachina robusta* Town,	Diptera,	C. W. Johnson,	- -	3	-

The Diptera listed in this table are named according to Aldrich's catalogue. Prof. C. W. Johnson of the Boston Society of Natural History has adopted changes in their names as follows: *Carcelia pyste* instead of *Exorista pyste; Phorocera claripennis* instead of *Euphorocera claripennis;* and *Exorista robusta* instead of *Tachina robusta*.

A small Trypetid was reared from cranberries in small numbers last year. Mr. F. L. Thomas, a graduate student at the Massachusetts Agricultural College who is making an exhaustive study of the Trypetidæ of New England, has determined this insect to be a small variety of the apple maggot (*Rhagoletis pomonella* Walsh).

Experimental Insect Work.

The experimental work with insects has been confined mostly to the flowed-bog fireworm (black head cranberry worm) and the fruit worm. The work with these two insects is here discussed in order.

The Flowed-bog Fireworm (*Rhopobota vacciniana* (Pack.)).

In last year's report on this insect, the successful results obtained in the treatment of a certain large bog by holding the winter flowage late (until June 2) and then reflowing about three weeks later to destroy an infestation were fully discussed. A somewhat similar procedure was carried out on another but smaller bog this season with much less satisfactory results, due probably to the fact that the reflowing was done too soon. The results of this treatment, all things considered, seemed, however, to be sufficiently successful to support the belief that where this method of treatment can be applied it will be found at least a fairly satisfactory one. The reflowage should evidently be continued for about forty-eight hours in this treatment.

The ideas advanced in last year's report, as to the way in which the bunching up of the hatching of the eggs of this insect is brought about by the late holding of the winter flowage, were evidently erroneous, as shown by observations made this year. Tests with thermometers made during the June reflows of the station bog showed that there are greater differences of temperature among the vines of a cranberry bog when the bog is flowed than when it is open to the air, the conditions in this respect being exactly the reverse of what they were last year presumed to be. It now seems probable that the bunching of the hatching by the late holding of the water is brought about mostly by a retardation or prohibition of hatching for the first eggs that reach or approach the hatching stage. It seems evident that the worms from any eggs, which might become far enough advanced to hatch under water, would drown soon after hatching, and it is not impossible that this is what really happens to the eggs soonest developed while the eggs of slower development are catching up with them as the warming up of the water in the late spring allows them to develop. It is, of course, evident that the whole hatching process is naturally more rapid under the hot sun of June than it is when the development of the

eggs and their hatching takes place in the cooler weather of the first half of May, as usually occurs when the winter flowage is drawn off early.

The general position taken in last year's report in regard to the practice of spraying for this insect should probably be maintained. It seems possible, however, that instead of using Bordeaux mixture and Paris green for this spraying it will be found best to use arsenate of lead alone, for while some of the results with Bordeaux mixture have been satisfactory, there seem to be indications, as hinted in the discussion of the fungous work, that it may be, under some conditions at least, an injurious spray to use. Experiments are planned to find out more exactly about this. On some bogs where Bordeaux mixture and Paris green were used on one part and arsenate of lead on another, this year, the arsenate seemed to give rather distinctly better results.

We have not yet learned what is the best method of applying a spray to a cranberry bog. There is considerable diversity of opinion and experiments are planned along this line. It seems probable that in thick vines a spray driven with a good deal of force will place poison where it will have a more satisfactory effect in destroying this insect than will the poison of a spray lightly applied.

From observations made on a considerable number of bogs this year the fireworm seems to be distinctly more injurious on vines of the Late Howe variety than on those of the Early Black, and it seems probable that the late Howe is a favorite variety with the pest. If this is the case it is only an added indication that where bogs are being newly built it is the part of wisdom to plant only one variety on a bog. It is now becoming generally recognized that the planting of several varieties together on the same bog causes more or less serious inconvenience in many ways.

A detailed account was given in last year's report concerning the parasites and other natural enemies of this insect and concerning the bearing which bog flooding has upon their effective activity. In connection with this, attention should have been drawn to the fact that when a bog is reflowed after picking, the most conspicuous forms of animal life that are driven ashore by the water, from the standpoint of their numbers, are the spiders. The number of these forms seen by one looking for them on the occasion of such after-harvest reflowing is really surprising, and it is interesting to note that most of them, even on a bog of considerable size, succeed in reaching the upland alive, as they are fitted to float lightly upon the surface of the water for considerable distances if need be. In all his examinations of bogs made during the process of the after-harvest reflow the writer has as yet failed to see a sufficient number of parasitic insects driven up by the water to lead him to believe that they can have nearly as important a bearing on the prevalence of the fireworm as do the spiders. It is probable, however, that the presence of the parasites on a bog is, in a sense, more affected by the flowing than is that of the spiders, because they are probably far more liable to destruction by drowning

than are the spiders, and, moreover, the parasites affecting the fireworm are probably more or less peculiar to it, while its spider enemies are presumably not so to any considerable extent.

The Fruit Worm (Mineola vaccinii (Riley)).

The chief work of the year with this insect has been a study of its natural enemies. Nearly a dozen species of its parasites have now been reared, and the complete life-history of the most important one was worked out in a general way. The connection of this parasitic insect with the fruit worm has not been heretofore suspected. Mr. H. L. Viereck, an expert on the group of insects to which it belongs, has determined it to be a Braconid, to which has been given the name *Phanerotoma tibialis* (Haldeman). This insect is seen on the cranberry bogs in large numbers every summer during and after the blooming period, but its presence has not been accounted for until now. This year it was seen in greatest numbers during the first three weeks of July. The adults had almost entirely disappeared from the bogs by July 26, it being possible to find only now and then one on that date.

A large number of wormy berries were collected during August, 1912, and kept in cans until Aug. 1, 1913. A careful record was made both of the moths and of the parasites which emerged from them. The wormy berries used in this investigation came from three general locations, as follows: —

1. The center of a flowed bog (station bog).
2. The edge of a flowed bog (station bog).
3. A dry bog (that is, one not flowed at any time).

The record of moth and parasite emergence was kept with these locations in mind. The most interesting points brought out by the record thus obtained were: —

1. That *Phanerotoma tibialis* far outnumbered all the other parasites taken together. All the parasites obtained from the berries collected at the center of the station bog, and all but one of those from the berries from the edge of this bog, were of this species. About four-fifths of the parasites from the berries collected from the dry bog were also of this species, but the percentage of other species of parasites was much greater among the forms obtained from the dry-bog berries than among those from the berries of the flowed bog.
2. The berries from the dry bog produced nearly three times as many parasites in proportion to the fruit-worm moths which emerged, as did the berries from any portion of the flowed bog.
3. The time of the greatest emergence of the parasites, from the berries from all three locations mentioned, was from June 30 to July 9, inclusive.
4. As slightly more parasites than moths emerged from the worms of the berries from the dry bog, it seems highly probable that more than 50 per cent. of the fruit worms on that bog last year were killed by these parasites. This shows something of the importance of the natural enemies of this insect which we have been in the habit of considering as being comparatively free from parasites.

It will be observed that the relative number of parasites obtained from the flowed bog and from the dry one shows a similar condition, as regards the amount of parasitism present on dry and flowed bogs, as that which has already been found to prevail with the natural enemies of the fire-worm. From a study of the life-history of *Phanerotoma tibialis*, however, it is not easy to see just how the flowage can affect its prevalence to so marked an extent.

It was found that the adult *Phanerotoma* lays its egg in the egg of the fruit worm. It was not difficult to get one of these parasites to lay its egg under observation, by bringing near it a berry bearing, under one of the lobes of its blossom end, an unhatched fruit-worm egg. During their laying season these parasites are constantly running over the vines with actively vibrating antennæ, searching for the eggs of the fruit worm, and when a fruit-worm egg is presented to one of them, if the parasite's antennæ sense its location, it will give immediate attention to it, and the whole process of egg-laying may be observed. A peculiar fact discovered was that one of these parasites will never lay twice in the same fruit-worm egg. One of them can, however, be readily induced to lay an egg in a fruit-worm egg which already contains one or even several (twelve was the highest number reached in any test) eggs deposited by other individuals. It is not known whether the egg of the parasite hatches before the fruit-worm egg does or not, but at any rate the fruit worm when it emerges from the egg carries the small parasite with it, and as the fruit worm grows, the parasite within it also grows, feeding upon its juices and so depleting its vitality that when it becomes full grown and forms a cocoon around itself for the winter it is often but little more than half the size of a normal unparasitized worm. Some time during the winter or spring the parasite larva becomes full grown, and, emerging from the fruit worm, leaves it a mere dead shell, and forms its own tiny white cocoon about itself within the cocoon of the fruit worm. Within its cocoon it changes into the pupa stage, and it eventually emerges as an adult parasite nearly a year after it was deposited as an egg in the egg of the fruit worm.

The second most important parasite which was reared is a small Ichneumon, which lays its egg in the fruit worm after the worm has hatched and is already working in the berry. The name of this species has not yet been determined. The female in laying its egg inserts its egg-laying apparatus into the hole in the berry made and left open by the fruit worm. This parasite was never seen to drive its egg-laying apparatus through one of the white silken curtains which the worm usually makes over the mouth of its hole after going into its first or second berry. The life-history of this parasite has not yet been worked out to any extent. It is certainly a far less important enemy of the fruit worm than is *Phanerotoma tibialis*.

A large quantity of wormy berries was collected in August for the purpose of making a detailed study of some of the immature stages of these parasites, particularly of *Phanerotoma tibialis*.

Study of Control for Flowed Bogs.

No very definite advance in our ideas concerning the control of this pest by flooding was made during the year. The recommendations given in last year's report still stand with no substantial alteration. It was suspected that the depth of the flowage had some bearing on its effect in killing the worms within their cocoons, as it seemed reasonable to suppose that the greater water pressure of a deep flowage would be more effective in collapsing or penetrating the cocoons than would be the slight pressure of a shallow flowage. To test this, different lots of fruit worms, spun up naturally in their cocoons, were submerged to various depths in water contained in long glass tubes 2 inches in diameter. The following table, showing the results of some of these tests, is self-explanatory: —

Table 6.

Date Submerged.	Date taken from Water.	Number sub-merged.	Depth of Submergence (Inches).	Cocoons occupied after Submergence.	Cocoons unoccupied after Submergence.	Number of Worms found Alive.	Number of Worms found Dead.
Oct. 8, 6 P.M.	Oct. 17, 5 P.M.	12	19	10	2	10	-
Oct. 8, 6 P.M.	Oct. 17, 5 P.M.	12	40	11	1	10	1 (?)
Oct. 8, 6 P.M.	Oct. 17, 5 P.M.	12	56	12	-	10	1[1]
Oct. 8, 6 P.M.	Oct. 17, 5 P.M.	12	68	12	-	10	2
Oct. 8, 6 P.M.	Oct. 17, 5 P.M.	9	80	9	-	8	1

It will be seen from this table that nine days of submergence, after the 8th of October, appeared to have but little effect on the worms at any depth tested. The remaining tests, not recorded in this table, gave results entirely similar. Possibly submergence earlier in the season would have been more effective in killing the worms. Bogs bearing late varieties could probably not, however, as a rule, be reflowed, after picking, before September 25, and it hardly seems probable that a difference of two weeks in the season would be sufficient to cause any marked difference in the effects of submergence on this insect. It may, of course, be possible to work in a flooding between the picking of the early and of the late varieties, but general experience appears to cast doubt upon the advisability of such a program.

An interesting fact learned while making these submergence tests was that the cocoons of the fruit worm are not at all impervious to water. When carefully opened, after only a few minutes' submergence, they were found to be wet inside, the water having apparently penetrated them almost immediately. It now seems evident that the cocoon protects the

[1] And 1 doubtful.

worm by preventing the escape of the vesicle of air which it contains, which the worm needs more than anything else in order to survive, rather than by keeping out the water by any imperviousness of its texture.

Study of Control for Dry Bogs.

The sanding experiment conducted last year to determine whether this insect could be smothered in its cocoon was repeated and continued this year on the same heavily infested bog, but the general results were unsatisfactory. It now seems pretty certain that this method of treatment for this insect will never be practicable.

In last year's report suggestions were made concerning the possibility of starving out fruit-worm infestations on dry bogs by killing the remnant of the bloom, in seasons of severe winter-kill injury or of severe frost damage, by spraying with a 20 per cent. solution of iron sulphate. First tests of the practicability of this method of treatment were made this year, and it was found that this solution can be used in such a way as to kill the bloom without apparent injury either to the vines or to the buds forming for the succeeding year's growth. It was necessary, however, to apply three rather thorough sprayings to accomplish the entire destruction of the blossom, because of the fact that the blossoming does not all take place at one time but is extended through a period of three or four weeks. The necessity of three sprayings instead of one has brought in a new element of danger which must be considered in connection with the practicability of this treatment. In making the 20 per cent. solution of iron sulphate 100 pounds of the chemical are used to every 50 gallons of water. It takes not less than 150 gallons to spray an acre thoroughly. This means that with each application 300 pounds of the iron sulphate would be put on each acre. Three applications would therefore deposit nearly half a ton of this chemical, per acre, on the bog. It seems probable that this amount of iron sulphate might injure the cranberry root system and perhaps kill the vines. Further experiments to determine about this are planned. If there proves to be no danger in this way, it seems probable that this method of treatment may be used to advantage on dry bogs.

8. WEEDS.

Horse-tail (*Equisetum* spp.) is one of the most troublesome weeds with which the cranberry grower has to contend. In general the growers show more concern over this weed than they do about any other. For this reason some attention was given to experimenting with it during the year. Solutions of copper sulphate as strong as 1 pound to 25 gallons of water were injected into a bog where this weed was growing in abundance to depths ranging from 6 inches to 2 feet, the solution being poured into holes a foot apart each way, made with a crow bar, a quart of the solution being used in each hole. Unfortunately, this treatment did not seem to affect the horse-tail injuriously, but rather seemed to cause it to thrive instead.

Thorough spraying with a 20 per cent. iron sulphate solution was fairly effective in killing back the tops of the weed, but there is, as has been already noted under the fruit-worm discussion, a possible danger connected with the continued use of this chemical on the same area.

9. RESANDING.

Plots O and V, spoken of in last year's report, were again left without resanding this year, while the surrounding bog was also not resanded. Three new plots, N, R and T, were laid out and resanded on Oct. 17, 1912, while the surrounding bog was not resanded again. All these plots were picked with scoops in 1913, and checks on each were laid out and picked for comparison. The following table is, in this connection, self-explanatory: —

TABLE 7.

PLOT.	Area of Plot (Square Rods).	Date picked.	Quantity of Fruit obtained (Bushels).	Percentage of Loss in Storage Tests.	Variety.
O, ...	9	Sept. 8	$12\frac{1}{2}$	$29\frac{2}{5}$	Early Black.
O (check 1), ...	9	Sept. 8	15	$28\frac{9}{10}$	Early Black.
O (check 2), ...	9	Sept. 8	$19\frac{1}{2}$	-	Early Black.
V, ...	9	Sept. 6	$18\frac{1}{6}$	$36\frac{3}{4}$	Early Black.
V (check 1), ...	9	Sept. 6	22	$41\frac{2}{10}$	Early Black.
V (check 2), ...	9	Sept. 6	$18\frac{2}{3}$	-	Early Black.
N, ...	9	Sept. 4	20	$38\frac{1}{4}$	Early Black.
N (check 1), ...	9	Sept. 4	$15\frac{1}{6}$	$30\frac{1}{7}$	Early Black.
N (check 2), ...	9	Sept. 4	25	-	Early Black.
N (check 3), ...	9	Sept. 4	$23\frac{1}{2}$	-	Early Black.
R, ...	9	Sept. 9	17	36	Early Black.
R (check 1), ...	9	Sept. 9	$16\frac{3}{4}$	$34\frac{2}{10}$	Early Black.
R (check 2), ...	9	Sept. 9	18	-	Early Black.
T, ...	9	Sept. 28	$20\frac{1}{2}$	$38\frac{3}{4}$	Howe.
T (check 1), ...	9	Sept. 28	19	$29\frac{2}{5}$	Howe.
T (check 2), ...	9	Sept. 28	23	-	Howe.

It will be seen from the above table that plots O and V showed a distinct falling off in quantity of fruit, due to the prolonged lack of resanding. Plots N, R and T, however, gave no increase in fruit over their checks, probably because the previous resanding of the general bog (fall of 1911) was still sufficient to maintain the vines in very good condition. Berries from all these plots and their checks were tested for keeping quality, the period of storage extending from October 28 to about December 20 on the average, there being a variation of five days in the time of final screening,

with the results given in the above table. The berries of the checks on each plot were mixed so as to have a single storage check in each case. The check storage figures given in the table, therefore, represent the mixture rather than the first check alone with which they are in each case associated. As the table shows, the berries of the unsanded plots, O and V, kept somewhat better on the average than did those of their checks, while the berries of the sanded plots, N, R and T, all showed a poorer keeping quality than did those of their checks. The results of these tests, therefore, substantiate the findings of last year.

10. MISCELLANEOUS.

During the fall the possibility of introducing cranberry vines for holiday decorations for dining rooms was investigated. A patch of Late Howe vines was left unpicked and was so protected from frost until into November, by covering with canvas, that it kept in good green condition. Some of these vines were cut and several wreaths and other decorations, bearing the natural fruit, were made from them, a damp moss foundation being used in every case. From the standpoint of beauty these decorations probably could not be easily surpassed, and there seemed for a time to be a considerable promise of success for them. It was found eventually, however, that even though plunged in wet moss the vines did not endure the heat of warm rooms for more than two or three days before they deteriorated badly in appearance. It became evident, therefore, that cranberry vines could not be used successfully in this way. Possibly, however, a satisfactory decoration could be made up by putting them in gold-fish jars for table ornamentation.

The results of the following spraying tests are of general interest, the spray in every case having been applied on a cranberry bog on the 29th of July: —

1. Plot sprayed with a mixture made up as follows: copper sulphate, 2 pounds; lime, 1½ pounds; resin fish-oil soap, 1 pound; arsenate of lead, 3 pounds; water, 25 gallons. No injury was later observed to have been caused by the application of this spray.

2. Plot sprayed with a mixture made up as follows: lime, 1½ pounds; resin fish-oil soap, 2 pounds; arsenate of lead, 3 pounds; water, 25 gallons. No injury was observed as a result of this application.

3. Plot sprayed with the following mixture: resin fish-oil soap, 2 pounds; arsenate of lead, 3 pounds; water, 25 gallons. The vines on this plot were badly burned by the treatment.

The interesting point shown by these three tests is that resin fish-oil soap and arsenate of lead cannot safely be used together as a spray unless lime is added. This confirms the general result of tests made in previous years, but not reported upon.

A plot was picked by hand in the three years 1911, 1912 and 1913 successively, the quantity of fruit it produced in comparison with the sur-

rounding bog being carefully noted each year, the general result being that no distinct advantage was shown for hand picking, from the standpoint of the quantity of fruit obtained.

The Station Bog Crop.

The bog bore a heavy crop this year, averaging about 100 barrels to the acre. This was probably largely due to the rest which the vines obtained because of last year's light crop. More water was pumped for irrigation this year than in 1912, but on the whole the bog was nevertheless run fairly dry throughout the season, the ditches not being held full of water for more than a day or two at a time. There is probably a limit beyond which a bog may become too dry if it is not irrigated. It seems probable that the wisest course to pursue, in irrigating a bog during the growing season, is to try to be sure that it has what water it needs, but that it is not given moisture much in excess of its needs. It is probably better to give a bog a good wetting occasionally and then draw off the surplus water, so that the ditches shall be fairly empty, than it is to keep the ditches full for any considerable period of time during the growing season and so run the risk of injuring the root system. The year's observations have confirmed those of last year in showing that the higher and better drained portions of a bog usually produce more fruit than the low portions. Blocks of vines from different parts of flowed and dry bogs were cut out during the season, and their root systems were washed out and examined, it being discovered from this that, while on dry bogs there is often a well-developed root growth running deep into the peat, the root system of flowed bogs is apparently always confined for the most part to the sand above the peat. It seems likely that this condition on the flowed bogs has been brought about by root drowning caused by holding the water table too high during periods of root growth. A mere examination, therefore, of the amounts of fruit borne by high and low portions of a bog is probably not sufficient to justify any certain conclusion concerning the causes of differences noted in the amount of fruit produced, for while a season's drainage is one possible important factor, the development of the root system, brought about by the conditions of previous seasons, is perhaps as likely to have a powerful influence on the ability of the plant to withstand drought, and therefore produce fruit under extreme conditions.

A Needed Investigation.

We are coming to understand something of the factors bearing directly on the portion of the cranberry plant which is above ground. While it is important to understand these more easily observed agencies bearing on the welfare of the plant, it seems certain that some of the most important things which influence cranberry growth and fruiting have been almost entirely neglected in our studies up to the present time. A knowledge of the special physiology of the plant, especially of the development and activities of its root system, seems to be very greatly needed. The sea-

sonal development of the root system of most plants begins fairly early in the spring and is nearly coincident with the development of the portions of the plant above ground. Recent investigations [1] by Professor Coville, of the Bureau of Plant Industry of the United States Department of Agriculture, have shown that with the blueberries, which are closely related to the cranberry, there is no new root growth until the plants have developed both their leaves and their blossoms. If this is also the rule in the development of the cranberry, it may have a rather vital bearing on the practices to be observed in the flooding and irrigation of cranberry bogs. A lot of vines have already been potted in earthen pots for this and other studies, and it is planned to pot more in glass pots, so that the growth of the root system may be directly observed in all its stages and in all seasons.

NOTES ON THE WATER OF CRANBERRY BOGS.[2]

Since 1910 the experiment station has been studying the properties and movements of the water in cranberry bogs, in order to determine the probable losses of fertility in the drainage water, because the bogs are generally flooded throughout the winter and sometimes for brief periods during the summer, as a protection against frost and insects.

The problem of fertilizing cranberry bogs to improve the crop is complicated by this periodical flowage and drainage. Many cranberry growers think that fertilizers are wasted if applied to the bogs, while actual field experiments in Massachusetts, New Jersey and Wisconsin have shown a positive benefit by a light top-dressing of soluble chemicals, namely, nitrates, superphosphates and potash salts.

The small experimental cranberry bogs in which the studies have been made were devised by Director Brooks, who has described them fully elsewhere.[3] It is deemed sufficient for this article to say that each bog is contained in an upright cylinder 24 inches in diameter and 48 inches in depth, constructed of glazed sewer tile bedded in concrete. Each bog is connected by a brass pipe passing through the concrete, with a smaller cylinder of similar construction, 6 inches in diameter and of the same depth as the bog. The small tile corresponds to the drainage ditch in the field, and is provided with an outlet and stopcock 12 inches below the level of the surface of the bog. By means of the smaller cylinder the bog can be drained or irrigated at will, and the depth of the water-level below the surface can be observed at any time.

At the approach of winter the bogs are fitted with galvanized iron rims cemented in place with an asphaltum cement, by which the water-level over the bogs may be raised to a height of about 12 inches. To prevent freezing and bursting the cylinders the entire set of bogs is covered with a

[1] Experiments in Blueberry Culture," by Frederick V. Coville, 1911. Bulletin No. 193 of the Bureau of Plant Industry, United States Department of Agriculture.

[2] By Fred W. Morse.

[3] Proc. Soc. Promotion Agri. Sci., 1911, pp. 23-28.

removable roof of boards which is further covered by cornstalks and hay to a depth sufficient to completely protect the interior from external temperature. As soon as freezing weather is over in the spring the covering of litter is removed, and later, at the proper season for draining the bogs, the roof is taken away.

The drainage from a cranberry bog consists of two quite distinct portions, namely, the run-off from the surface and the seepage from the soil, while there is the ditch water at the beginning of drainage, which is a mixture of both kinds. On a properly graded bog nearly all the surface flowage should run directly into the ditches without seeping through the soil. On the other hand, water retained by the vines and in depressions in the surface of the bog, together with the water held in the pore-space of the sand and peat above the level of the sluice gates, must either evaporate or sink lower into the bog, and as it settles it displaces the saturated bog water, which seeps into the ditches.

The composition of the three types of drainage water has been carefully followed season by season, and it is believed that some light has been obtained on the probable losses of fertility.

The surface water is removed from the experimental bogs by means of a dipper, because their construction does not permit it to be drawn off otherwise without losing its identity. Its composition has been found to be essentially like any surface water from ponds and streams. The surface waters from four bogs that had been top-dressed with a complete fertilizer in 1911 were examined in the spring of 1912, in comparison with the surface water from four bogs which had received no fertilizer. Total solids and organic solids were first determined with the following results: surface water contained in 100,000 parts, 16.0 parts total residue and 4.8 parts organic matter from the fertilized bogs while the surface water from the unfertilized bogs contained 19.2 parts total residue and 6.4 parts organic matter. No nitrates were found, and as the fertilized bogs had not imparted any increase of soluble matter to their flood waters it was not deemed worth while to carry the analysis further. The run-off cannot be considered as removing from the bogs any serious amount of fertility, since its composition cannot vary widely from the water when applied, except for the soluble matter that is extracted from the vines.

The water standing in the small cylinders at the time the surface water was dipped from the bogs is nearly the counterpart of the ditch water after the run-off has past and seepage begins. That is, it is a mixture of surface water and seepage water. A number of analyses have been made of the water at this stage, because there are possibilities for considerable variation, and it will be noted in the table that there is a wide range between the two seasons.

TABLE 1. — *Composition of Ditch Water.*

[Parts in 100,000.]

Bog.	May 4 and 9, 1912.		
	Total Residue.	Organic Matter.	Total Nitrogen.
8 (A and B),	71.1	38.6	1.42
9 (A and B),	64.3	33.6	1.38
14 (A and B),	56.2	26.2	1.15
15 (A and B),	52.3	26.3	1.36

Bog.	May 8 and 9, 1913.			
	Total Residue.	Organic Matter.	Total Nitrogen.	Potash.
4 (A and B),	37.0	12.2	0.28	-
5 (A and B),	38.0	11.4	0.40	3.8
6 (A and B),	40.4	10.8	0.56	3.1
7 (A and B),	56 2	15.2	0.90	4.6
8 (A and B),	60.6	14.4	0.91	4.7
9 (A and B),	46.8	13.0	0.45	3.6
10 (A and B),	65.2	17.4	0.56	-
12 (A and B),	56.8	15.8	0.91	-

To estimate the probable losses from a bog it would be necessary to know the capacity of the ditches, since the small cylinders in our experiments bear a much larger proportion to the bog's surface than occurs in field practice.

The average content of nitrogen in the ditch water was 1.33 parts in 100,000 in 1912, and 0.62 part in 100,000 in 1913. Potash was determined only in 1913, when the average content was 3.96 parts in 100,000. Fifty thousand gallons of ditch water, containing 0.98 part of nitrogen and 3.96 parts of potash in 100,000 parts of water, would carry away a trifle more than 4 pounds of nitrogen and 16 pounds of potash. It would also be equivalent in volume to the water contained in a ditch 3 feet deep, 2 feet wide and a little over 67 rods long, which would be more ditch than is usually employed on an acre of cranberry bog.

The mixture of surface and seepage water in the small cylinder of the experimental bogs may or may not closely resemble similar water in the ditches of large bogs. It is the writer's opinion that the latter water would be even more dilute, since a sample of ditch water collected at the

experimental bog in East Wareham contained only 21.3 parts of total solids and 12.1 parts of organic solids in 100,000 parts of water at a time when Dr. H. J. Franklin, the superintendent of the bog, deemed the ditch water to be at its normal state, with no irrigation water mixed with it. There was but 0.28 part of total nitrogen in 100,000 parts, and bare traces of phosphates and potash in this water.

The seepage water, which is practically the same thing as the saturated soil water from the interior of the peat, is noticeably uniform in composition throughout the season, and the average composition for 1912 is very close to that of 1911, published in the twenty-fourth annual report.[1]

TABLE 2. — *Composition of Seepage Water, 1912.*

Total Residue and Organic Matter.

[Parts in 100,000.]

Bog.	May 14.		May 22.		June 10.		June 17.	
	Total Residue.	Organic Matter.	Total Residue.	Organic Matter.	Total Residue.	Organic Matter.	Total Residue.	Organic Matter.
8 (A and B),	101.0	53.0	114.8	52.0	-	-	109.4	60.6
9 (A and B),	91.4	50.6	118.4	54.2	-	-	114.0	63.4
10 (A and B),	119.4	62.8	144.5	75.1	-	-	132.0	74.4
12 (A and B),	95.0	51.0	111.4	51.4	113.0	62.8	-	-
13 (A and B),	98.6	52.0	124.2	59.2	91.8	63.4	-	-
14 (A and B),	102.0	50.2	137.2	76.0	134.6	67.2	-	-
15 (A and B),	105.5	54.4	122.1	62.7	104.2	57.2	120.0	67.4

Fertility Constituents.

[Parts in 100,000.]

Bog.	Total Nitrogen.					Phosphoric Acid.		Potash.	
	May 14.	May 22.	June 10.	June 17.	June 25.	May 22.	June 10.	May 22.	June 10.
8 (A and B), .	2.45	3.04	-	2.66	-	-	-	-	-
9 (A and B), .	2.13	3.08	-	2.52	-	-	-	-	-
10 (A and B), .	3.01	3.96	-	3.36	3.38	-	1.78	7.75	-
12 (A and B), .	2.27	3.15	2.94	-	3.05	1.19	1.55	7.44	-
13 (A and B), .	2.38	3.22	2.90	-	2.69	1.17	-	7.29	6.15
14 (A and B), .	2.27	3.32	-	-	3.01	1.14	1.48	-	8.12
15 (A and B), .	2.59	3.43	3.32	2.73	-	-	2.00	-	6.62

[1] Mass. Agr. Sta., 24th An. Rept., Pt. I., p. 220.

The amount of this seepage must vary from season to season. The spring seasons of 1912 and 1913 were unusually wet for about three weeks after the surfaces of the bogs were drained, and several rains made it necessary to open repeatedly the stopcocks in the drainage cylinders. The amount of seepage determined by the amount of water which flowed through the outlets amounted to 25.6 quarts per bog in 1912 and 24.5 quarts in 1913, or, in round numbers, a little over 90,000 gallons per acre in the first year and over 85.000 gallons in the second, or an average weight of over 700,000 pounds of water per acre, which would contain, discarding fractions, more than 21 pounds nitrogen, 10 pounds of phosphoric acid and 50 pounds of potash.

There was no evidence that the application of fertilizers in the previous year caused any increase in these substances.

Fertilizer Scheme for Bogs.

Bogs numbered 6, 10, 11 and 14 receive no fertilizers.
Bog numbered 1 received nitrate of soda.
Bog numbered 2 received acid phosphate.
Bog numbered 3 received sulfate of potash.
Bog numbered 4 received nitrate and phosphate.
Bog numbered 5 received nitrate and potash.
Bog numbered 7 received phosphate and potash.
Bogs numbered 8, 9, 12, 13 and 15 receive all three substances.

The period of seepage was succeeded in both seasons by a short space of time during which the water-level fluctuated within narrow limits, and following this interval was a prolonged dry season during which it was necessary to add water repeatedly to the small cylinders to replace the amount of water evaporated from the surface of the bogs. The addition of this water gradually changed the composition of the water in the cylinders until it showed that practically all of the original seepage water had been reabsorbed by the peat. This showed that there was no apparent diffusion from bog to cylinder, and there must be actual movement of water from the bog to cause any loss to the bog of its soluble matter.

The permanent losses of fertility are limited to the seepage water which actually flows away from the ditches into the main drain or stream passing through a bog. They cannot be avoided; but there is no evidence that the small additions of chemicals in the late spring increase the losses any.

The amount of water required for irrigation was determined in both years by measuring the quantities added from time to time to the small cylinders. These cylinders were kept covered with galvanized iron caps, so that evaporation and rainfall would affect only the surface of the bogs. Water was added on seven different dates in the summer of 1912, beginning with July 3 and ending on August 16. In 1913 there were eleven different dates beginning with June 19 and ending on August 28.

The total amount added in 1912 was 13.75 gallons per bog, equivalent to a depth of 7 inches over the surface, while in the yet drier season of 1913, 23.75 gallons were required per bog, or a depth of 12 inches.

During 1912 it was noticeable that some bogs evaporated much more rapidly than others; but the actual differences were not determined. In the fall, before putting on the sheet-iron rims, it was necessary to cut off the vines which extended over the wall of the tile, and also to cut out some of the surplus growth within the bog area. These prunings were dried and weighed, and were found to vary much. There also appeared to be some relationship between the weight of prunings and the rate of water movement in the bogs, which was to be expected, since transpiration should increase with the development of the vines.

Therefore in 1913 a careful record was kept of the amounts of water removed from individual bogs as drainage water in the spring and the quantities of irrigation water added during the summer. The results, together with the weight of vines removed the previous fall, are given in Table 3, as follows: —

TABLE 3. — *Relation between Drainage, Irrigation and Vine Growth.*

Bog.	Drainage (Quarts).	Irrigation (Quarts).	Vines (Grams).	Bog.	Drainage (Quarts).	Irrigation (Quarts).	Vines (Grams).
6A, . .	25.1	88.0	190.7	6B, . .	21.5	103.0	184.2
10A, . .	21.0	98.0	187.1	10B, . .	28.5	107.0	295.8
14A, . .	19.5	95.0	185.2	14B, . .	18.4	85.0	140.5
11A, . .	3.1	64.0[1]	38.0	11B, . .	23.5	96.0	184.3
2A, . .	28.9	102.0	123.2	2B, . .	30.0	113.0	221.7
3A, . .	24.5	100.0	165.4	3B, . .	28.9	120.0	238.9
7A, . .	22.9	85.0	124.1	7B, . .	28.2	114.0	298.3
1A, . .	10.8	85.0	98.5	1B, . .	6.4	62.0	91.4
4A, . .	32.0	117.0	258.9	4B, . .	31.3	117.0	302.1
5A, . .	28.1	101.0	213.9	5B, . .	23.3	96.0	216.6
8A, . .	23.6	89.0	186.8	8B, . .	25.6	98.0	226.6
9A, . .	23.3	83.0	187.8	9B, . .	24.8	93.0	221.8
12A, . .	27.1	100.0	252.5	12B, . .	28.3	103.0	235.4
13A, . .	25.3	92.0	178.3	13B, . .	25.6	93.0	214.3
15A, . .	30.9	93.0	231.2	15B, . .	22.9	85.0	173.0

Excluding 1A, 1B and 11A, the averages for 27 bogs are: drainage, 25.6 quarts; irrigation, 98.7 quarts; vines, 208.8 grams.

The bogs are arranged so that the unfertilized ones, 6, 10, 11 and 14, head the columns, followed by 2, 3 and 7 with no nitrogen, while 1, 4 and 5 receive nitrogen in nitrate of soda, and 8, 9, 12, 13 and 15 are dressed with complete fertilizers, including nitrates.

It will be noted that neither nitrogen nor other fertilizers were responsible for large vine growth, but that in 12 out of 14 bogs having vine

[1] Water applied to surface of bog.

growth above the average, the drainage from the bogs in the spring was above the average, and in 10 cases the irrigation was high also. On the other hand, bogs 1A, 1B and 11A, in which the water movement was notably slow, yielded the smallest weights of vines when pruned.

In a large proportion of the bogs the growth of vines appeared to be related to the freedom with which the soil permitted the water to move from bog to drain and back again. Not only was more water evaporated during the summer, but these bogs permitted rapid percolation or seepage in the spring into the small cylinders. The bogs with small vine growth were slow to drain in the spring, and much of the water evaporated from the surface of the bog instead of seeping into the drainage cylinder.

In conclusion our observations show that the principal losses of fertility are in the seepage water which may escape from the ditches, and that the vine growth is more influenced by the free movement of water than by fertilizers.

The assistance of Mr. R. W. Rupreeht in measuring the water, and of Mr. R. L. Coffin in pruning and weighing the vines, is gratefully acknowledged.

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AGRICULTURAL EXPERIMENT STATION

THE DETERMINATION OF ACETYL NUMBER

BY

EDW. B. HOLLAND

This bulletin presents the results of an effort made to devise and perfect a process for the determination of acetyl number in oils and fats that shall be free from the objections noted in earlier methods.

Requests for bulletins should be addressed to the
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CONTENTS.

THE DETERMINATION OF ACETYL NUMBER.[1]

EDW. B. HOLLAND.

Introduction.

The various hydroxy compounds that occur in oils, fats and waxes form derivatives on heating with acetic anhydride, the acetyl radical displacing the hydrogen of the alcoholic hydroxyl groups. This property serves as the basis of analytical methods for the quantitative determination of these compounds. The proposed acetyl number indicates the milligrams of potassium hydroxide required for the saponification of the acetyl assimilated by one gram of an oil, fat or wax on acetylation.[2] On saponifying with alcoholic potash the acetyl is hydrolyzed to acetic acid and combines with the alkali to form potassium acetate. The results are expressed in terms of milligrams of potassium hydroxide to conform with the general practice in fat analysis. The compounds involved are monohydroxy and dihydroxy acids and their glycerides, — monoglycerides and diglycerides and free alcohols.

Use of the Test.

In the examination of oils and fats a determination of acetyl number is necessary, in most instances, for a thorough understanding of the nature and quality of the product. Some of the hydroxy compounds are natural and others are the result of hydrolysis or of oxidation. Glycerides of hydroxy acids are a natural constituent of certain oils and fats, although they do not appear to be very widely distributed in any considerable amount. Castor oil, composed largely of ricinolein, is a notable illustration. Hydroxy acids probably occur more frequently as the result of oxidation of unsaturated acids. Oleic acid has been shown repeatedly to be comparatively unstable. By the assimilation of oxygen and water it may be converted into dihydroxystearic acid, a saturated compound.

$$C_{17}H_{33}COOH + H_2O + O = C_{17}H_{33}(OH)_2COOH.$$

Whether the oxidation takes place in the glycerides or in the fatty acids after hydrolysis is uncertain, although the latter appears the more probable supposition.

Monoglycerides and diglycerides result from the hydrolysis of triglycerides, and free fatty acids condition their presence. The absence of

[1] The writer is pleased to acknowledge many suggestions and helpful criticisms by Dr. J. S. Chamberlain, Mr. F. W. Morse, Mr. J. C. Reed and Mr. J. P. Buckley.

[2] Benedikt and Ulzer, and Lewkowitsch report on the basis of the acetylated product.

free fatty acids in a commercial product, however, does not necessarily preclude the presence of monoglycerides and diglycerides.

Solid alcohols of the cyclic series (sterols) occur in oils and fats both in combination as esters and as free alcohols.[1] The amount of cholesterol or phytosterol is generally small, often inappreciable, and is indicated approximately by the unsaponifiable matter which it characterizes. Alcohols of the ethane and other series, free and in combination, compose a considerable proportion of waxes.

Oils and fats, therefore, may contain glycerides of monohydroxy and dihydroxy acids, possibly free hydroxy acids, monoglycerides and diglycerides and free alcohols; and the insoluble acids, separated from the oils and fats, may contain monohydroxy and dihydroxy acids and free alcohols. A portion, at least, of the free alcohols found in the insoluble acids probably occurred in the fat as esters. With the exclusion of the natural glycerides of hydroxy acids and a small amount of free alcohols, the acetyl number of many oils and fats may be deemed an index of quality, and when considered in conjunction with the acid and iodine numbers may serve to measure (more or less imperfectly, to be sure) the amount of hydrolysis and of oxidation the product has undergone. To differentiate between products of hydrolysis and of oxidation the acetyl number of the insoluble acids should also be determined.

Earlier Methods.

The several analytical processes that have been offered are based on the same chemical reactions, but differ in application and in details of procedure. The original method was devised by Benedikt and Ulzer[2] and applied to the insoluble acids. The acetyl number indicated the milligrams of potassium hydroxide required to neutralize the acetic acid obtained on saponifying one gram of acetylated insoluble fatty acids, and was determined by the difference between the acid and saponification numbers of the acetylated acids (acetyl ether number). The actual procedure consisted in saponifying the acetylated acids after neutralizing in alcohol. Lewkowitsch[3] has shown, however, that the results so obtained were generally in excess of the true values, due to the conversion of a part of the fatty acids on heating with a large excess of acetic anhydride into their anhydrides, as illustrated by the following equation: —

$$\underset{\text{fatty acid}}{2\,RCOOH} + \underset{\substack{\text{acetic}\\\text{anhydride}}}{(CH_3CO)_2O} = \underset{\substack{\text{anhydride of}\\\text{fatty acid}}}{(RCO)_2O} + \underset{\text{acetic acid}}{2\,CH_3COOH}$$

These fatty anhydrides are fairly stable compounds, but may become hydrolyzed to some extent on washing with boiling water. Subsequent treatment with cold alcohol in the determination of the acetyl acid

[1] See numerous references: Abderhalden, Physiological Chemistry (1908); Hammarsten, Physiological Chemistry (1911); Leathes, The Fats (1910).

[2] Monatsh. Chem., 8, pp. 41–48 (1887).

[3] Analysis of Oils, Fats and Waxes, 1, pp. 344, 345 (1909).

number will continue the hydrolysis, although a portion is likely to remain unchanged, thereby yielding too low an acid number, due to the inability of the anhydrides to combine with alkali. As complete hydrolysis occurs on saponification, the acetyl (ether) number would be too high and even appear when none exists.

Lewkowitsch[1] proposed the acetylation of the natural product. In conformity thereto the acetyl number indicates the milligrams of potassium hydroxide required for the neutralization of the acetic acid obtained on saponifying one gram of an acetylated oil, fat or wax. This method requires the saponification of the acetylated fat and the determination of the resulting acetic acid by either a filtration or distillation process. The former process is an adaptation of the regular method for the direct determination of soluble acids, and the latter process is a modified Reichert-Meissl test, with repeated distillation of the aqueous solution until the distillate is free from acids. The presence of natural soluble or volatile acids necessitates a similar treatment of the unacetylated fat in order to determine the amount of alkali assimilated by those acids for which proper corrections must be made to obtain the true acetyl number. The occurrence of the lower acids makes the determination a long and tedious operation.

Proposed Method.

Analytical methods for the examination of oils and fats is a subject that has been given considerable study by the writer in connection with feeding experiments and other investigations made at the Massachusetts Agricultural Experiment Station. During the past few years the determination of acetyl number has received particular attention with a view to evolving a process that might be free from the objections cited for the Benedikt and Ulzer, and Lewkowitsch methods. Believing that this end has been attained in some measure, a report of progress is now offered in the hope that it may lead to further improvement.

The custom of reporting acetyl number on the basis of the acetylated product appears unwarranted. It is contrary to general practice in analytical work and is the exception in fat analysis. The definition[2] here adopted places the acetyl number on a par with other tests, and is as follows: the acetyl number indicates the milligrams of potassium hydroxide required for the saponification of the acetyl assimilated by one gram of an oil, fat or wax on acetylation.

Method in Detail.

The development of the method extended over a period of several years, and finally resolved into an adaptation of several well-known processes. For instance, ceresine is used to solidify the acetylated fat so that it may be washed by decantation as in the determination of insoluble

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[1] *Loco citato*, 1, pp. 337, 338 (1909).

[2] The hydroxyl value of Twitchell is reported in a similar manner. Jour. Amer. Chem. Society, 29, pp. 566–571 (1907).

acids. The saponification number of the acetylated fat is determined by the same process as that of the original fat, and the difference measures the amount of acetyl that has been assimilated. The process may be appropriately described as a method by analogy.

The reagents employed in the determination are summarized so that their application may be clearly understood: —

Acetic anhydride, Kahlbaum's.

Ceresine, pure white, filtered.

Alcohol, redistilled, free from acids and aldehydes.

Alcoholic potash, 50 c.c. of a saturated solution of potassium hydroxide, free from carbonate, to 1,000 c.c. of alcohol. The solution should be allowed to stand at least twenty-four hours and filtered immediately before use.

$N/_2$ hydrochloric acid.

Alkali blue (6B), 1 gram to 100 c.c. of alcohol. The indicator should be digested in a stoppered bottle for several days at room temperature, with occasional shaking, and then filtered.

Phenolphthalein, 1 gram to 100 c.c. of alcohol, neutralized.

After what has been said, the details of the method should be so evident as to require no further explanation.

Into a 300 c.c. Erlenmeyer flask are brought 5 grams of fat, together with 10 c.c. of acetic anhydride. The flask is connected with a spiral or other form of reflux condenser and heated in a boiling water bath (immersed in the water) for from one to one and one-half hours. Longer heating yields higher results, but is accompanied by partial decomposition of the fat with formation of aldehydes or other bodies that give a reddish color with caustic alkali. After acetylating, the flask is removed from the bath and sufficient ceresine added to form, with the fat, a solid disc when chilled in cold water. The amount of ceresine required will vary with the consistency of the product under examination. For butter fat .4 to .5 grams is ample; for softer fats and oils rather more; and for harder fats, less. The flask is heated on the water bath and the contents rotated until the ceresine and acetylated fat form a homogeneous mixture. One hundred and fifty c.c. of boiling water are then poured carefully into the flask with as little disturbance of the fat layer as possible, and the solution heated on the bath with occasional agitation to remove occluded acetic acid. The flask is immersed in cold water to solidify the ceresine-fat, after which the solution is decanted through a dense, ether-extracted filter, care being taken not to break the insoluble cake. Another 150 c.c. of boiling water are added, thoroughly agitated, heated as above, cooled and decanted, the process being repeated until the final filtrate gives a decided color with two or three drops of $N/_{10}$ alkali, using phenolphthalein as indicator (about six times). Prolonged washing is likely to cause slight dissociation of the acetylated product.

The filter and inverted flask containing the cake of ceresine-fat are allowed to drain in a cool place until practically dry. The small particles adhering to the filter are then scraped into the flask, and 50 c.c. of alcoholic potash, accurately measured with a burette, 50 c.c. of alcohol and several glass beads added. The flask is connected with a spiral or other form of reflux condenser and the solution boiled on a water bath until saponification is complete, — about sixty minutes. The flask is placed in a water bath at 60° C. and the solution, after cooling to that temperature, titrated with $N/_2$ hydrochloric acid, using 1 c.c. of alkali blue as indicator. Phenolphthalein may be employed, though less satisfactory for colored solutions. The alcoholic mixture is again brought to boil to free any alkali occluded in the ceresine, and retitered if necessary. Several blank determinations should

be run with every series of tests under precisely similar conditions as to time and treatment, except that the ceresine may be omitted. However, every lot of ceresine must be tested, should be free from soluble matter and not assimilate any alkali on saponification. The difference between the titration of the blank and that of the excess alkali in the test is the acid equivalent of the fat after acetylation, which should be calculated to milligrams of potassium hydroxide for 1 gram of fat.

One c.c. of $N/_2$ acid is equivalent to 28.054 milligrams of potassium hydroxide.

The difference between the saponification number of the fat before and after acetylation is the acetyl number. In case the original fat contains *free soluble* acids, their titer should be determined and proper correction made for the same.

Limit of error, 0.50 acetyl number.

Synopsis of Reaction.

A better conception of the method may be obtained by a summary of the reactions: —

Acetylation of glycerides of monohydroxy and dihydroxy acids, monoglycerides and diglycerides and free alcohols. (See formulas.)
Saponification of the acetylated product. (See formulas.)
Saponification of the original or unacetylated product.
Titration of excess alkali.
Acetyl number by difference.

Glycerides of Monohydroxy and Dihydroxy Acids.

Acetylation: —

$$\underset{\text{triglyceride of monohydroxy acid}}{(R.OH.COO)_3C_3H_5} + \underset{\text{acetic anhydride}}{3(CH_3CO)_2O} = \underset{\text{acetylated glyceride}}{(R.OCH_3CO.COO)_3C_3H_5} + \underset{\text{acetic acid}}{3\,CH_3COOH}$$

Example: Ricinolein $(C_{17}H_{32}.OH.COO)_3C_3H_5$

Saponification: —

$$\underset{\text{acetylated glyceride}}{(R.OCH_3CO.COO)_3C_3H_5} + \underset{\text{alkali}}{6\,KOH}$$

$$= \underset{\text{potassium salt of hydroxy acid}}{3\,R.OH.COOK} + \underset{\text{potassium acetate}}{3\,CH_3COOK} + \underset{\text{glycerol}}{C_3H_5(OH)_3}$$

$$\underset{\text{triglyceride of dihydroxy acid}}{[R(OH)_2COO]_3C_3H_5} + (CH_3CO)_2O = \underset{\text{acetylated glyceride}}{[R(OCH_3CO)_2COO]_3C_3H_5} + H_2O$$

Example: Dihydroxystearin $[C_{17}H_{33}(OH)_2COO]_3C_3H_5$

$$[R(OCH_3CO)_2COO]_3C_3H_5 + 9\,KOH = 3\,R(OH)_2COOK + 6\,CH_3COOK + C_3H_5(OH)_3$$

Monoglycerides and Diglycerides.

$$\underset{\text{monoglyceride}}{(RCOO)C_3H_5(OH)_2} + (CH_3CO)_2O = \underset{\text{diaceto-glyceride}}{(RCOO)(CH_3COO)_2C_3H_5} + H_2O$$

$$(RCOO)(CH_3COO)_2C_3H_5 + 3\,KOH = RCOOK + 2\,CH_3COOK + C_3H_5(OH)_3$$

$$\underset{\text{diglyceride}}{(RCOO)_2C_3H_5(OH)} + (CH_3CO)_2O = \underset{\text{monaceto-glyceride}}{(RCOO)_2(CH_3COO)C_3H_5} + CH_3COOH$$

$$(RCOO)_2(CH_3COO)C_3H_5 + 3\,KOH = 2\,RCOOK + CH_3COOK + C_3H_5(OH)_3$$

Free Alcohols.

$$\underset{\text{monobasic alcohol}}{ROH} + (CH_3CO)_2O = \underset{\text{acetate of alcohol}}{CH_3COOR} + CH_3COOH$$

$$CH_3COOR + KOH = ROH + CH_3COOK$$

Examples: Cholesterol, phytosterol, $C_{27}H_{45}OH$

Considerable variation is possible in writing the above formulas which, at best, poorly express the structure. In some instances the reaction is indicated at some sacrifice of form.

Calculated Data from the Acetyl Number.

The acetyl number (c) serves to measure the amount of hydroxy compounds in an oil, fat or wax; and in case only one such compound of known molecular weight (m) and number of hydroxyls (d) is present, its amount (H) can be readily calculated by the following formula: —

$$H = \frac{cm}{56108\ d}$$

The derivation of the formula is comparatively simple. The theoretical acetyl number of a compound containing (d) hydroxyl groups is —

$$\frac{56108\ d}{m}$$

The amount of such a compound in an oil, fat or wax is, therefore —

$$\frac{c}{\frac{56108\ d}{m}} = \frac{cm}{56108\ d}$$

The same results may be calculated more easily from the following table, dividing the determined acetyl number by the theoretical acetyl number, or multiplying by its reciprocal: —

Acetyl Number on Original Product (Massachusetts Method).

Glycerides.

Name.	Formula.	Molecular Weight.	Saponification Number.	Theoretical Acetyl Number.	Reciprocal.
Ricinolein,	$(C_{17}H_{32}.OH.COO)_3C_3H_5$,	932.832	180.444	180.444	.0055419
Dihydroxy-stearin,	$[C_{17}H_{33}(OH)_2COO]_3C_3H_5$,	956.880	170.562	341.124	.0029315
Monoglycerides.					
Monopalmitin,	$C_{15}H_{31}COO.C_3H_5(OH)_2$,	330.304	169.868	339.736	.0029435
Monostearin,	$C_{17}H_{35}COO.C_3H_5(OH)_2$,	358.336	156.579	313.159	.0031933
Monolein,	$C_{17}H_{33}COO.C_3H_5(OH)_2$,	356.320	157.465	314.930	.0031753

Acetyl Number on Original Product (Massachusetts Method) — Con.

Diglycerides.

NAME.	Formula.	Molecular Weight.	Saponification Number.	Theoretical Acetyl Number.	Reciprocal.
Dipalmitin,	$(C_{15}H_{31}COO)_2C_3H_5(OH)$,	568.544	197.374	98.687	[illegible]
Distearin,	$(C_{17}H_{35}COO)_2C_3H_5(OH)$,	624.608	179.655	89.829	[illegible]
Diolein,	$(C_{17}H_{33}COO)_2C_3H_5(OH)$,	620.576	180.824	90.413	[illegible]
	Hydroxy Acids.				
Ricinoleic,	$C_{17}H_{32}$.OH.COOH,	298.272	188.111	188.111	[illegible]
Dihydroxystearic,	$C_{17}H_{33}(OH)_2COOH$,	316.288	177.365	354.731	[illegible]
	Free Alcohols.				
Cholesterol,	$C_{27}H_{45}OH$,	386.368	–	145.219	[illegible]
Phytosterol,	$C_{27}H_{45}OH$,	386.368	–	145.219	[illegible]

GRAVIMETRIC PROCESS.[1]

After acetylating, a gravimetric process for acetyl number may be conducted in a manner similar to that for the quantitative determination of insoluble fatty acids, observing all the precautions therein noted as to ceresine, washing, drying, weighing, etc.

This modification is apparently rather more difficult, tedious and subject to error than the saponification or volumetric process (Massachusetts method). A certain amount of loss arises from the dehydration of free fatty acids by acetic anhydride during acetylation, and is difficult to prevent, although of little consequence where the amount of free acids is relatively small.

The acetyl number (a) is calculated from the increase in weight (i) by the following formula: —

$$a = \frac{56108\,i}{42.016} \text{ or } 1335.39604\,i$$

In case only one hydroxy compound of known molecular weight (m) and number of hydroxyls (d) is present, its amount can be calculated from the increase in weight (i) of the oil, fat or wax on acetylating. The theoretical increase for a hydroxy compound is —

$$\frac{42.016\,d}{m}$$

[1] This process has not received sufficient study in this laboratory to warrant positive statements, but is similar to the methods described by Lewkowitsch (loc. cit.), I, pp. 355–358, 466, 467.

The amount (H) of such a compound in an oil, fat or wax is therefore —

$$H = \frac{i}{\frac{42.016\,d}{m}} \text{ or } \frac{im}{42.016\,d}$$

Molecular Weight of Hydroxy Compounds.

The molecular weight of the hydroxy compounds can be calculated from the weight (w) of fat taken and the increase (i) on acetylating, provided the number (d) of hydroxyls in the molecule is known: —

$$w : w+i = m : m+42.016\,d$$

$$m = \frac{42.016\,dw}{i}$$

The formation of anhydrides during the acetylating process will affect the accuracy of these calculations.

The computation of the amount of hydroxy compounds by the gravimetric process is greatly facilitated by use of the following table: —

Acetyl Gravimetric Process on Original Product.

Glycerides.

Name.	Molecular Weight.	Molecular Weight after Acetylating.	Theoretical Increase in Weight per Gram on Acetylating.[1]	Reciprocal.
Ricinolein,	932.832	1058.880	.135124	7.40061
Dihydroxystearin,	986.880	1238.976	.255447	3.91471
Monoglycerides.				
Monopalmitin,	330.304	414.336	.254408	3.93069
Monostearin,	358.336	442.368	.234506	4.26428
Monolein,	356.320	440.352	.235833	4.24029
Diglycerides.				
Dipalmitin,	568.544	610.560	.073901	13.53162
Distearin,	624.608	666.624	.067268	14.86591
Diolein,	620.576	662.592	.067705	14.76996
Hydroxy Acids.				
Ricinoleic,	298.272	340.288	.140865	7.09900
Dihydroxystearic,	316.288	400.320	.265682	3.76390
Free Alcohols.				
Cholesterol,	386.368	428.384	.108746	9.19574
Phytosterol,	386.368	428.384	.108746	9.19574

[1] Acetyl number = 1335.39604 i.

Acetyl Number of Insoluble Fatty Acids.

The acetyl number of the insoluble fatty acids is determined by the Massachusetts method in precisely the same way as that of the original fat. The gravimetric process is not applicable on account of the formation of anhydrides of the fatty acids. The method for preparing the stock of insoluble acids for analysis is the same as that for the determination of "Insoluble Acids," with the elimination of such features as are necessary only for quantitative work.

In order to interpret the results satisfactorily it is necessary to know the percentage of insoluble acids so that the acetyl number of the acids may be considered in conjunction with the acetyl number of the fat.

Results by Different Methods.

For convenience, the theoretical acetyl numbers of some hydroxy compounds by the Benedikt and Ulzer, and Lewkowitsch methods are tabulated to permit comparison with the acetyl numbers by the Massachusetts and gravimetric processes previously stated. When only one hydroxy compound of known composition is present in an oil or fat the results can be readily converted from the basis of the original to that of the acetylated product and vice versa. In other cases conversion is generally impracticable on account of the marked differences in assimilation of acetyl by the several classes of hydroxy compounds. Formulas may show the relation, however, that the results by different methods bear to each other, (m) indicating the molecular weight of the hydroxy compound, (d) the number of hydroxyls, and (i) the increase in weight on acetylating: —

Massachusetts Method.

$$\frac{cm}{56108\ d}$$

Gravimetric Method.

$$\frac{im}{42.016\ d}$$

Benedikt and Ulzer, and Lewkowitsch Methods.

$$\frac{c(m + 42.016\ d)}{56108\ d}$$

Acetyl Number on Acetylated Product. (Benedikt and Ulzer, and Lewkowitsch Methods.)

Glycerides.

Name (Acetylated).	Formula.	Molecular Weight.	Saponification Number.	Theoretical Acetyl Number.	Reciprocal.
Ricinolein,	$(C_{17}H_{32}.OCH_3CO.COO)_3C_3H_5$,	1058.880	317.928	158.964	.0062907
Dihydroxystearin,	$[C_{17}H_{33}(OCH_3CO)_2COO]_3C_3H_5$,	1238.976	407.572	271.715	.0036803
Monoglycerides.					
Monopalmitin,	$(C_{15}H_{31}COO)(CH_3COO)_2C_3H_5$,	414.336	406.250	270.833	.0036923
Monostearin,	$(C_{17}H_{35}COO)(CH_3COO)_2C_3H_5$,	442.368	380.507	253.671	.0039421
Monolein,	$(C_{17}H_{33}COO)(CH_3COO)_2C_3H_5$,	440.352	382.249	254.832	.0039242
Diglycerides.					
Dipalmitin,	$(C_{15}H_{31}COO)_2(CH_3COO)C_3H_5$,	610.560	275.688	91.896	.0108819
Distearin,	$(C_{17}H_{35}COO)_2(CH_3COO)C_3H_5$,	666.624	252.502	84.167	.0118811
Diolein,	$(C_{17}H_{33}COO)_2(CH_3COO)C_3H_5$,	662.592	254.039	84.680	.0118092
Hydroxy Acids.					
Ricinoleic,	$C_{17}H_{32}.OCH_3CO.COOH$,	340.288	329.768	164.884	.0060649
Dihydroxystearic,	$C_{17}H_{33}(OCH_3CO)_2COOH$,	400.320	420.474	280.316	.0035674
Free Alcohols.					
Cholesterol,	$CH_3COO\ C_{27}H_{45}$,	428.384	-	130.976	.0076350
Phytosterol,	$CH_3COO\ C_{27}H_{45}$,	428.384	-	130.976	.0076350

Résumé.

The acetyl numbers of a fat and of the insoluble acids afford valuable information relative to the nature and the quality of a product. Apparently many analysts have been deterred from making the determinations on account of the time required, tedious manipulation involved or inability to interpret the results. The proposed method is comparatively short and simple and readily understood because of its similarity to other fat methods in common use. It is practically free from the objections cited for the earlier methods, and the results are directly comparable with other fat determinations, being on the same basis.

BULLETIN No. 152 MAY, 1914

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

THE DIGESTIBILITY OF CATTLE FOODS

By J. B. LINDSEY and P. H. SMITH

This bulletin contains the results of forty-seven single digestion experiments with a variety of cattle feeds. The experiments include trials with English hay, corn meal, gluten feed, dried beet pulp, cocoanut meal, cottonseed feed meal, wheat screenings, flax shives, cocoa shells, fish meal, Molassine meal, Postum Cereal and Mellen's Food residues. The hay, corn and gluten were used as basal rations, to which were added the materials to be tested. The full data of each experiment are first given, and the results are discussed in a separate chapter.

The bulletin is not intended for general distribution but more particularly for experiment station workers and others who will utilize the data in determining the relative value of feeding stuffs.

Requests for bulletins should be addressed to the

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Amherst, Mass.

Massachusetts Agricultural Experiment Station.

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THE DIGESTIBILITY OF CATTLE FOODS.

BY J. B. LINDSEY AND P. H. SMITH.

FOREWORD.

The digestion experiments herein reported were made during the autumn, winter and early spring of 1910–11, 1911–12, 1912–13 and also, two experiments, in the autumn of 1913. They form part of what are known as Series XVI., XVII., XVIII. and XIX. The experiments made in these series and not here included have either been published in previous reports or will be found in later publications.

The usual method was employed and has been fully described elsewhere.[1] The full data are here presented, with the exception of the daily production of manure and the daily water consumption, in which cases, to economize space, averages only are given. The periods extended over fourteen days, the first seven of which were preliminary, collection of feces being made during the last seven. Ten grams of salt were given each sheep daily with water *ad libitum.* The sheep used in these experiments were grade Shropshires of substantially uniform weight, born in 1907.

1. SERIES XVI.

The hay used in connection with this series consisted of fine mixed grasses, and contained a large proportion of June grass (*Poa pratensis*). The digestion coefficients of this hay, as obtained in Period I., were applied to the two experiments on beet pulp which follow: —

[1] Eleventh report of the Mass. State Agr. Exp. Sta., pp. 146–149; also the 22d report of the Mass. Agr. Exp. Sta., p. 84.

Composition of Feedstuffs (Per Cent.).

[Dry Matter.]

Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
English hay, Period I.,	7.47	9.58	30.98	49.36	2.61
English hay, Period II.,	6.96	9.90	31.39	49.13	2.62
English hay, Period III.,	6.66	9.64	30.76	50.46	2.48
Waste, Sheep I., Period I.,	8.89	5.86	36.92	46.94	1.39
Molasses dried beet pulp,	5.56	11.68	16.40	65.89	.47
Plain dried beet pulp,	3.29	8.12	20.46	67.76	.37

Composition of Feces (Per Cent.).

[Dry Matter.]

Sheep I.

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay,	13.61	11.82	25.82	45.49	3.26
II.	Molasses dried beet pulp,	13.15	15.27	24.46	43.03	4.09
III.	Dried beet pulp,	12.20	13.49	25.81	44.63	3.87
Sheep II.						
I.	English hay,	13.37	11.13	28.27	44.32	2.91
II.	Molasses dried beet pulp,	13.67	15.69	25.10	41.87	3.67
III.	Dried beet pulp,	11.98	12.37	27.55	44.25	3.85

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Air-dry Feces (Per Cent.).

Sheep I.

Period.	English Hay.	Molasses Dried Beet Pulp.	Dried Beet Pulp.	Waste.	Feces.
I.,	88.55	-	-	83.40	93.62
II.,	89.85	89.60	-	-	92.25
III.,	90.90	-	89.64	-	88.83
Sheep II.					
I.,	88.55	-	-	-	93.57
II.,	89.85	89.60	-	-	92.47
III.,	90.90	-	89.64	-	89.02

Average Daily Amount of Manure excreted and Water drunk (Grams).

Sheep I.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
I.	English hay,	627	27.600	1,512
II.	Molasses dried beet pulp,	684	23.470	1,893
III.	Dried beet pulp,	695	26.097	1,829

Sheep II.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
I.	English hay,	1,032	30.768	2,465
II.	Molasses dried beet pulp,	983	24.881	2,611
III.	Dried beet pulp,	605	27.486	1,946

Weights of Animals for Two Days at Beginning and Two Days at the End of Period (Pounds).

Sheep I.

Period.	Character of Food or Ration.	Beginning.		End.	
		First Weight.	Second Weight.	First Weight.	Second Weight.
I.	English hay,	122.00	121.75	120.00	119.00
II.	Molasses dried beet pulp,	128.25	126.50	125.25	126.25
III.	Dried beet pulp,	126.25	127.00	125.25	125.00

Sheep II.

Period.	Character of Food or Ration.	Beginning.		End.	
		First Weight.	Second Weight.	First Weight.	Second Weight.
I.	English hay,	125.00	128.50	126.50	126.50
II.	Molasses dried beet pulp,	142.25	141.50	140.25	140.00
III.	Dried beet pulp,	140.75	139.75	138.50	138.50

English Hay, Period I.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed daily,	708.40	52.92	67.86	219.46	349.67	18.49
13.75 grams waste,	11.47	1.02	.67	4.23	5.39	.16
Amount consumed,	696.93	51.90	67.19	215.23	344.28	18.33
276.03 grams manure excreted,	258.42	35.17	30.55	66.72	117.56	8.42
Grams digested,	438.51	16.73	36.64	148.51	226.72	9.91
Per cent. digested,	62.92	32.24	54.53	69.00	65.85	54.06

English Hay, Period I — Concluded.

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed daily,	708.40	52.92	67.86	219.46	349.67	18.49
307.68 grams manure excreted,	287.90	38.49	32.04	81.39	127.60	8.38
Grams digested,	420.50	14.43	35.82	138.07	222.07	10.11
Per cent. digested,	59.36	27.27	52.79	62.91	63.51	54.68
Average per cent. for both sheep,	61.14	29.76	53.66	65.96	64.68	54.37

Average nutritive ratio of rations for both sheep, 1:10.7.

Molasses Dried Beet Pulp, Period II.

Sheep I.

500 grams English hay fed,	449.25	31.27	44.48	141.02	220.71	11.77
300 grams molasses dried beet pulp fed,	268.80	14.94	31.40	44.08	177.12	1.26
Amount consumed,	718.05	46.21	75.88	185.10	397.83	13.03
234.70 grams manure excreted,	216.51	28.47	33.06	52.96	93.16	8.86
Grams digested,	501.54	17.74	42.82	132.14	304.67	4.17
Minus hay digested,	274.04	9.38	24.02	93.07	143.46	6.36
Molasses dried beet pulp digested,	227.50	8.36	18.80	39.07	161.21	-
Per cent. digested,	84.64	55.96	59.87	88.63	91.02	-

Sheep II.

Amount consumed as above,	718.05	46.21	75.88	185.10	397.83	13.03
248.81 grams manure excreted,	230.07	31.45	36.10	57.75	96.33	8.44
Grams digested,	487.98	14.76	39.78	127.35	301.50	4.59
Minus hay digested,	274.04	9.38	24.02	93.07	143 46	6 36
Molasses dried beet pulp digested,	213.94	5.38	15.76	34.28	158.04	-
Per cent. digested,	79.57	36.01	50.19	77 77	89 23	-
Average per cent. for both sheep,	82.11	45.99	55.03	83 20	90.13	-

Average nutritive ratio of rations for both sheep, 1:10.7.

Dried Beet Pulp, Period III.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	499.95	33.30	48.20	153.78	252.27	12.40
250 grams dried beet pulp fed,	224.10	7.37	18.19	45.86	151.85	.83
Amount consumed,	724.05	40.67	66.39	199.64	404.12	13.23
260.97 grams manure excreted,	231.82	28.28	31.27	59.83	103.47	8.97
Grams digested,	492.23	12.39	35.12	139.81	300.65	4.26
Minus hay digested,	304.97	9.99	26.03	101.49	163.98	6.70
Dried beet pulp digested,	187.26	2.40	9.09	38.32	136.67	-
Per cent. digested,	76.72	32.56	49.97	83.56	90.00	-

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	724.05	40.67	66.39	199.64	404.12	13.23
274.86 grams manure excreted,	244.68	29.31	30.27	67.41	108.27	9.42
Grams digested,	479.37	11.36	36.12	132.23	295.85	3.81
Minus hay digested,	304.97	9.99	26.03	101.49	163.98	6.70
Dried beet pulp digested,	174.40	1.37	10.09	30.74	131.87	-
Per cent. digested,	71.45	18.59	55.47	67.03	86.84	-
Average per cent. for both sheep,	74.09	25.58	52.72	75.30	88.42	-

Average nutritive ratio of rations for both sheep, 1:12.4.

2. Series XVII.

Digestion Coefficients of Basal Ration used in this Series.

[English Hay.]

	Periods I.-VII.	Periods VIII.-X.
Dry matter,	62	65
Ash,	34	46
Protein,	55	65
Fiber,	68	67
Nitrogen-free extract,	65	67
Fat,	48	46

Composition of Feedstuffs (Per Cent).

[Dry Matter.]

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay, ...	7.75	9.06	31.65	49.16	2.38
II.	English hay, ...	7.51	9.44	31.73	48.96	2.36
II.	Cocoanut meal, ...	6.97	21.17	9.23	52 58	10.05
III.	English hay, ...	8.19	10.36	30.46	48.37	2.62
III.	Cottonseed feed meal, Creamo brand,	5 28	23.75	21.22	44.32	5.43
IV.	English hay, ...	7.65	10.02	32.48	47.58	2.27
IV.	Wheat screenings, ...	5.19	17 20	10.52	60.05	7.04
V.	English hay, ...	6.92	10.17	30.65	49.92	2.34
V.	Molasses dried beet pulp, . . .	5.69	11.44	15.88	66.72	.27
V.	Dried beet pulp, ...	3.16	8.01	27.22	61.38	.23
VI.	English hay, ...	6.26	9.50	32.52	49.18	2.54
VI.	Flax shives, ...	5.59	16.54	35.90	38.75	3.22
VII.	English hay, ...	7.13	9.85	30.91	49.66	2.45
VII.	Cocoanut meal, ...	6.06	21.58	9.83	52.42	10.11
VIII.	English hay, ...	6.73	10.37	30.18	49.84	2.88
IX.	English hay, ...	5.70	9.90	30.50	51.03	2.87
IX.	Cocoa shells, ...	8.83	14.55	13.25	58 23	5.14
X.	English hay, ...	5.46	9.40	31.35	50 77	3.02
X.	Wheat screenings, ...	4.28	17.50	8.29	64.66	5.27

Composition of Feces (Per Cent).

[Dry Matter.]

Sheep I.

IX.	Cocoa shells, ...	10.88	15.09	26.20	44.45	3.38

Sheep II.

IX.	Cocoa shells, ...	10.94	14.13	25.14	46.38	3.41

Sheep III.

V.	Dried beet pulp, ...	12.31	13.00	20.13	50.50	4.06

Sheep IV.

IV.	Molasses dried beet pulp, . . .	12.17	13.00	27.00	43.82	4.01

Composition of Feces (Per Cent.) — Concluded.

Sheep V.

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay,	13.65	10.80	27.32	45 04	3.19
III.	Cottonseed feed meal, Creamo brand,	12.25	13.11	28 23	43 89	2.52
IV.	Wheat screenings,	12.07	10 95	28 21	45 89	2.88
VI.	Flax shives,	9.66	9 20	35.55	43.26	2.33
VII.	Cocoanut meal,	12.12	11.51	28.81	44 74	2.82
VIII.	English hay,	9.87	10.30	28 36	47.35	4.12
X.	Wheat screenings,	10.48	11.74	28.47	45.35	3 96

Sheep VI.

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay,	13.50	10.68	26.56	45.88	3.38
II.	Cocoanut meal,	13.24	11.93	27.40	44.57	2.86
III.	Cottonseed feed meal, Creamo brand,	11.93	12.50	29.55	43.37	2.65
IV.	Wheat screenings,	12 36	10.79	27.77	46.20	2 88
VI.	Flax shives,	9.91	9.27	34.88	43.55	2.39
VII.	Cocoanut meal,	12.48	11.22	28 80	44.71	2 79
VIII.	English hay,	10.88	10 53	27 61	46.21	4 47
X.	Wheat screenings,	11.22	11.96	28.54	44.40	3 88

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Air-dry Feces (Per Cent.).

Sheep I.

Period.	English Hay.	Molasses Dried Beet Pulp.	Dried Beet Pulp.	Cocoa Shells.	Feces.
IX.,	89.20	-	-	95.47	92.18
Sheep II.					
IX.,	89.20	-	-	95 47	92 38
Sheep III.					
V.,	92.97	-	90.92	-	94.91
Sheep IV.					
V.,	92.97	94.04	-	-	94 85

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Air-dry Feces (Per Cent.) — Concluded.

Sheep V.

Period.	English Hay.	Cocoanut Meal.	Cotton-seed Feed Meal.	Wheat Screenings.	Flax Shives.	Feces.
I.,	88.50	-	-	-	-	93.30
III.,	87.57	-	89.70	-	-	93.77
IV.,	89.45	-	-	91.94	-	95.41
VI.,	93.25	-	-	-	90.02	95.16
VII.,	90.70	92.86	-	-	-	93.68
VIII.,	90.67	-	-	-	-	92.94
X.,	89.47	-	-	88.52	-	93.11

Sheep VI.

Period.	English Hay.	Cocoanut Meal.	Cotton-seed Feed Meal.	Wheat Screenings.	Flax Shives.	Feces.
I.,	88.50	-	-	-	-	93.25
II.,	87.82	88.37	-	-	-	93.52
III.,	87.57	-	89.70	-	-	94.06
IV.,	89.45	-	-	91.94	-	95.44
VI.,	93.25	-	-	-	90.02	95.18
VII.,	90.70	92.86	-	-	-	93.75
VIII.,	90.67	-	-	-	-	93.03
X.,	89.47	-	-	88.52	-	93.32

Average Daily Amount of Manure excreted and Water drunk (Grams).

Sheep I.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
IX.	Cocoa shells,	898	28.76	2,168

Sheep II.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
IX.	Cocoa shells,	661	28.40	2,510

Sheep III.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
V.	Dried beet pulp,	590	26.33	1,975

Sheep IV.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
V.	Molasses dried beet pulp,	708	24.75	2,482

Average Daily Amount of Manure excreted and Water drunk (Grams) — Concluded.

Sheep V.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
I.	English hay,	559	29.30	971
III.	Cottonseed feed meal, Creamo brand,	554	29.08	1,493
IV.	Wheat screenings,	586	29.55	951
VI.	Flax shives,	752	35.84	1,691
VII.	Cocoanut meal,	580	27.13	1,839
VIII.	English hay,	583	27.93	1,902
X.	Wheat screenings,	739	26.85	2,202

Sheep VI.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
I.	English hay,	554	28.07	1,474
II.	Cocoanut meal,	498	25.50	1,403
III.	Cottonseed feed meal, Creamo brand,	570	29.40	2,011
IV.	Wheat screenings,	583	28.95	2,165
VI.	Flax shives,	685	34.67	2,806
VII.	Cocoanut meal,	556	26.31	3,141
VIII.	English hay,	536	26.97	3,289
X.	Wheat screenings,	662	26.09	3,494

Weights of Animals for Two Days at Beginning and Two Days at the End of Period (Pounds).

Sheep I.

Period.	Character of Food or Ration.	Beginning.		End.	
		First Weight.	Second Weight.	First Weight.	Second Weight.
IX.	Cocoa shells,	146.50	144.00	142.50	142.50

Sheep II.

Period.	Character of Food or Ration.	Beginning. First Weight.	Beginning. Second Weight.	End. First Weight.	End. Second Weight.
IX.	Cocoa shells,	143.50	142.50	143.00	143.00

Sheep III.

Period.	Character of Food or Ration.	Beginning. First Weight.	Beginning. Second Weight.	End. First Weight.	End. Second Weight.
V.	Dried beet pulp,	160.00	158.75	162.00	160.50

Weights of Animals for Two Days at Beginning and Two Days at the End of Period (Pounds) — Concluded.

Sheep IV.

Period.	Character of Food or Ration.	Beginning. First Weight.	Beginning. Second Weight.	End. First Weight.	End. Second Weight.
V.	Molasses dried beet pulp,	164.50	163.00	163.00	162.50

Sheep V.

Period.	Character of Food or Ration.	Beginning. First Weight.	Beginning. Second Weight.	End. First Weight.	End. Second Weight.
I.	English hay,	163.25	163.25	159.25	160.75
III.	Cottonseed feed meal, Creamo brand,	158.25	159.25	158.25	156.50
IV.	Wheat screenings,	158.75	158.00	159.50	157.00
VI.	Flax shives,	168.50	167.50	164.75	164.75
VII.	Cocoanut meal,	167.50	169.75	165.50 163.25	163.00 166.25
VIII.	English hay,	163.50	161.50	162.50	161.50
X.	Wheat screenings,	162.00	161.50	158.50	157.50

Sheep VI.

Period.	Character of Food or Ration.	Beginning. First Weight.	Beginning. Second Weight.	End. First Weight.	End. Second Weight.
I.	English hay,	146.75	146.75	146.75	147.00
II.	Cocoanut meal,	146.75	145.00	143.50	145.50
III.	Cottonseed feed meal, Creamo brand,	141.50	142.00	141.00	139.25
IV.	Wheat screenings,	143.00	142.00	141.25	139.50
VI.	Flax shives,	156.50	157.00	154.25	154.50
VII.	Cocoanut meal,	151.50	151.50	153.50 152.50	152.00 150.00
VIII.	English hay,	151.00	151.75	152.00	150.50
X.	Wheat screenings,	150.00	149.50	148.00	148.25

English Hay, Period I.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed,	708.00	54.87	64.14	224.08	348.06	16.85
293 grams manure excreted,	273.37	37.32	29.52	74.68	123.13	8.72
Grams digested,	434.63	17.55	34.62	149.40	224.93	8.13
Per cent. digested,	61.39	31.98	53.98	66.67	64.62	48.25

English Hay, Period I — Concluded.

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed,	708.00	54.87	64.14	224.08	348.06	16.85
280.67 grams manure excreted,	261.72	35.33	27.95	69.51	120.08	8.85
Grams digested,	446.28	19.54	36.19	154.57	227.98	8.00
Per cent. digested,	63.03	35.61	56.42	68.98	65.50	47.48
Average per cent. for both sheep,	62.21	33.80	55.20	67.83	65.06	47.87

Average nutritive ratio of rations for both sheep, 1:11.2.

Cocoanut Meal, Period II.

Sheep VI.

650 grams English hay fed,	570.83	42.87	53.87	181.13	279.49	13.47
150 grams cocoanut meal fed,	132.56	9.24	28.06	12.24	69.70	13.32
Amount consumed,	703.39	52.11	81.93	193.37	349.19	26.79
255 grams manure excreted,	238.48	31.57	28.45	65.34	106.30	6.82
Grams digested,	464.91	20.54	53.48	128.03	242.89	19.97
Minus hay digested,	353.91	14.58	29.63	123.17	181.67	6.47
Cocoanut meal digested,	111.00	5.96	23.85	4.86	61.22	13.50
Per cent. digested,	83.74	64.50	85.00	39.71	87.83	101.35

Average nutritive ratio of ration, 1:7.8.

Cottonseed Feed Meal, Creamo Brand, Period III.

Sheep V.

600 grams English hay fed,	525.42	43.03	54.43	160.04	254.15	13.77
200 grams cottonseed feed meal fed,	179.40	9.47	42.61	38.07	79.51	9.74
Amount consumed,	704.82	52.50	97.04	198.11	333.66	23.51
290.8 grams manure excreted,	272.68	33.40	35.45	76.98	119.68	6.87
Grams digested,	432.14	19.10	61.59	121.13	213.98	16.64
Minus hay digested,	325.76	14.63	29.94	108.83	165.20	6.61
Cottonseed feed meal digested,	106.38	4.47	31.65	12.30	48.78	10.03
Per cent. digested,	59.30	47.20	74.28	32.31	61.35	102.97

Cottonseed Feed Meal, Creamo Brand, Period III — Concluded.

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	704.82	52.50	97.04	198.11	333.66	23.51
293.99 grams manure excreted,	276.53	32.99	34.57	81.71	119.93	7.33
Grams digested,	428.29	19.51	62.47	116.40	213.73	16.18
Minus hay digested,	325.76	14.63	29.94	108.83	165.20	6.61
Cottonseed feed meal digested,	102.53	4.88	32.53	7.57	48.53	9.57
Per cent. digested,	57.15	51.53	76.34	19.88	61.04	98.25
Average per cent. for both sheep,	58.23	49.37	75.31	26.10	61.20	100.61

Average nutritive ratio of rations for both sheep, 1:5.94.

Wheat Screenings, Period IV.

Sheep V.

600 grams English hay fed,	536.70	41.06	53.78	174.32	255.36	12.18
200 grams wheat screenings fed,	183.88	9.54	31.63	19.34	110.42	12.95
Amount consumed,	720.58	50.60	85.41	193.66	365.78	25.13
295.54 grams manure excreted,	281.97	34.03	30.88	79.54	129.40	8.12
Grams digested,	438.61	16.57	54.53	114.12	236.38	17.01
Minus hay digested,	332.75	13.96	29.58	118.54	165.98	5.85
Wheat screenings digested,	105.86	2.61	24.95	-	70.40	11.16
Per cent. digested,	57.57	27.36	78.88	-	63.76	86.18

Sheep VI.

Amount consumed as above,	720.58	50.60	85.41	193.66	365.78	25.13
289.51 grams manure excreted,	276.31	34.15	29.81	76.73	127.66	7.96
Grams digested,	444.27	16.45	55.60	116.93	238.12	17.17
Minus hay digested,	332.75	13.96	29.58	118.54	165.98	5.85
Wheat screenings digested,	111.52	2.49	26.02	-	72.14	11.32
Per cent. digested,	60.65	26.19	82.97	-	65.33	87.41
Average per cent. for both sheep,	59.11	26.73	80.93	-	64.55	86.80

Average nutritive ratio of rations for both sheep, 1:7.1.

Dried Beet Pulp, Period V.

Sheep III.

—	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed, ...	511.34	35.39	52.00	156.73	255.25	11.97
250 grams dried beet pulp fed, . .	227.30	7.18	18.21	61.87	139.52	.52
Amount consumed, ...	738.64	42.57	70.21	218.60	394.77	12.49
263.27 grams manure excreted, . .	249.87	30.76	32.48	50.30	126.19	10.14
Grams digested, ...	488.77	11.81	37.73	168.30	268.58	2.35
Minus hay digested, ...	317.03	12.03	28.60	106.58	165.91	5.75
Dried beet pulp digested, . . .	171.74	-	9.13	61.72	102.67	-
Per cent. digested, ...	75.56	-	50.14	99.76	73.59	-

Average nutritive ratio of ration, 1:11.7.

Molasses Dried Beet Pulp, Period V.

Sheep IV.

550 grams English hay fed, . . .	511.34	35.39	52.00	156.73	255.25	11.97
250 grams molasses dried beet pulp fed,	235.10	13.38	26.90	37.33	156.86	.63
Amount consumed, ...	746.44	48.77	78.90	194.06	412.11	12.60
247.50 grams manure excreted, . .	234.75	28.57	30.52	63.38	102.87	9.41
Grams digested, ...	511.69	20.20	48.38	130.68	309.24	3.19
Minus hay digested, ...	317.03	12.03	28.60	106.58	165.91	5.75
Molasses dried beet pulp digested, .	194.66	8.17	19.78	24.10	143.33	-
Per cent. digested, ...	82.80	61.06	73.53	64.56	91.37	-

Average nutritive ratio of ration, 1:9.2.

Flax Shives, Period VI.

Sheep V.

600 grams English hay fed, . . .	559.50	35.02	53.15	181.95	275.17	14.21
250 grams flax shives fed, . . .	225.05	12.58	37.22	80.79	87.21	7.25
Amount consumed, ...	784.55	47.60	90.37	262.74	362.38	21.46
358.38 grams manure excreted, . .	341.03	32.94	31.37	121.24	147.53	7.95
Grams digested, ...	443.52	14.66	59.00	141.50	214.85	13.51
Minus hay digested, ...	346.89	11.91	29.23	123.73	178.86	6.82
Flax shives digested, ...	96.63	2.75	29.77	17.77	35.99	6.69
Per cent. digested, ...	42.94	21.86	79.98	22.00	41.27	92.26

Flax Shives, Period VI — Concluded.

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	784.55	47.60	90.37	262.74	362.38	21.46
346.74 grams manure excreted,	330.03	32.71	30.59	115.11	143.73	7.89
Grams digested,	454.52	14.89	59.78	147.63	218.65	13.57
Minus hay digested,	346.89	11.91	29.23	123.73	178.86	6.82
Flax shives digested,	107.63	2.98	30.55	23.90	39.79	6.75
Per cent. digested,	47.82	23.69	82.08	29.58	45.63	93.09
Average per cent. for both sheep,	45.38	22.78	81.03	25.79	43.45	92.68

Average nutritive ratio of rations for both sheep, 1:6.6.

Cocoanut Meal, Period VII.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams English hay fed,	589.55	42.03	58.07	182.23	292.78	14.44
150 grams cocoanut meal fed,	139.29	8.44	30.06	13.69	73.02	14.08
Amount consumed,	728.84	50.47	88.13	195.92	365.80	28.52
271.34 grams manure excreted,	254.19	30.81	29.26	73.23	113.72	7.17
Grams digested,	474.65	19.66	58.87	122.69	252.08	21.35
Minus hay digested,	365.52	14.29	31.94	123.92	190.31	6.93
Cocoanut meal digested,	109.13	5.37	26.93	-	61.77	14.42
Per cent. digested,	78.34	63.63	89.59	-	84.59	102.41

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	728.84	50.47	88.13	195.92	365.80	28.52
263.11 grams manure excreted,	246.67	30.78	27.68	71.04	110.29	6.88
Grams digested,	482.17	19.69	60.45	124.88	255.51	21.64
Minus hay digested,	365.52	14.29	31.94	123.92	190.31	6.93
Cocoanut meal digested,	116.65	5.40	28.51	.96	65.20	14.71
Per cent. digested,	83.74	63.98	94.84	7.01	89.29	104.47
Average per cent. for both sheep,	81.04	63.81	92.22	-	86.94	103.44

Average nutritive ratio of rations for both sheep, 1:7.1.

English Hay, Period VIII.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed,	725.36	48.82	75.22	218.91	361.52	20.89
279.28 grams manure excreted,	259.56	25.62	26.73	73.61	122.91	10.69
Grams digested,	465.80	23.20	48.49	145.30	238.61	10.20
Per cent. digested,	64.22	47.52	64.46	66.37	66.00	48.83

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed,	725.36	48.82	75.22	218.91	361.52	20.89
269.70 grams manure excreted,	250.90	27.30	26.42	69.27	115.94	11.97
Grams digested,	474.46	21.52	48.80	149.64	245.58	8.92
Per cent. digested,	65.41	44.08	64.88	68.36	67.93	42.70
Average per cent. for both sheep,	64.82	45.80	64.67	67.37	66.97	45.77

Average nutritive ratio of rations for both sheep, 1:8.4.

Cocoa Shells, Period IX.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams English hay fed,	579.80	33.05	57.40	176.83	295.88	16.64
150 grams cocoa shells fed,	143.21	12.65	20.84	18.98	83.38	7.36
Amount consumed,	723.01	45.70	78.24	195.81	379.26	24.00
287.64 grams manure excreted,	265.15	28.85	40.01	69.47	117.86	8.96
Grams digested,	457.86	16.85	38.23	126.34	261.40	15.04
Minus hay digested,	376.87	15.20	37.31	118.48	198.24	7.65
Cocoa shells digested,	80.99	1.65	.92	7.86	63.16	7.39
Per cent. digested,	56.55	13.04	4.41	41.41	75.75	100.41

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	723.01	45.70	78.24	195.81	379.26	24.00
284.01 grams manure excreted,	262.37	28.70	37.07	65.96	121.69	8.95
Grams digested,	460.64	17.00	41.17	129.85	257.57	15.05
Minus hay digested,	376.87	15.20	37.31	118.48	198.24	7.65
Cocoa shells digested,	83.77	1.80	3.86	11.37	59.33	7.40
Per cent. digested,	58.49	14.23	18.52	59.91	71.16	100.54
Average per cent. for both sheep,	57.52	13.64	11.47	50.66	73.46	100.48

Average nutritive ratio of rations for both sheep, 1:10.6.

Wheat Screenings, Period X.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed,	536.82	29.31	50.46	168.29	272.55	16.21
200 grams wheat screenings fed,	177.04	7.58	30.98	14.68	114.47	9.33
Amount consumed,	713.86	36.89	81.44	182.97	387.02	25.54
268.48 grams manure excreted,	249.98	26.20	29.35	71.17	113.36	9.90
Grams digested,	463.88	10.69	52.09	111.80	273.66	15.64
Minus hay digested,	348.93	13.48	32.80	112.75	182.61	7.46
Wheat screenings digested,	114.95	-	19.29	-	91.05	8.18
Per cent. digested,	64.93	-	62.26	-	79.54	87.67

Sheep VI.

Amount consumed as above,	713.86	36.89	81.44	182.97	387.02	25.54
260.94 grams manure excreted,	243.51	27.32	29.12	69.50	108.12	9.45
Grams digested,	470.35	9.57	52.32	113.47	278.90	16.09
Minus hay digested,	348.93	13.48	32.80	112.75	182.61	7.46
Wheat screenings digested,	121.42	-	19.52	-	96.29	8.63
Per cent. digested,	68.58	-	63.01	-	84.12	92.50
Average per cent. for both sheep,	66.76	-	62.64	-	81.83	90.09

Average nutritive ratio of rations for both sheep, 1:8.1.

3. Series XVIII.

Digestion Coefficients of Basal Ration used in this Series.

	English Hay. Sheep I. and II.	English Hay. Sheep V. and VI.	English Hay and Corn Meal. Periods X. and XII. Sheep I. and II.
Dry matter,	65	65	70
Ash,	31	46	43
Protein,	61	65	63
Fiber,	70	67	71
Nitrogen-free extract,	67	67	74
Fat,	53	46	59

Composition of Feedstuffs (Per Cent.).

[Dry Matter.]

Period.	Feedstuffs.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay,	4 90	9 75	31 46	50.95	2.94
II.	English hay,	5 78	9.56	31 48	50.45	2.73
II.	Corn meal,	1.39	10 74	2.77	80.07	5.03
VIII.	Brook Farm hay,	6.46	8 27	33.89	49.31	2.07
VIII.	Waste Sheep I.,	4.68	4 56	38 09	51.61	1.06
VIII.	Waste Sheep II.,	6.09	7.28	33.46	51.48	1.69
IX.	English hay,	6.53	9.35	32.10	49.13	2.89
IX.	CXX Feed, Postum Cereal refuse.	2.74	19.57	18.11	56 46	3.12
X.	English hay,	6 41	9.80	31.84	49.31	2.64
X.	Corn meal,	1.46	10.93	2.60	80 15	4.86
X.	Gloucester fish meal,	24.01	73 17	–	–	2.82
XI.	English hay,	6 72	9 72	31 65	49.32	2.59
XI.	Molassine meal,	9 40	10.81	7.54	71.72	.53
XII.	English hay,	6.49	9.62	31.64	49.51	2.74
XII.	Corn meal,	1.50	10 78	2 72	80 15	4.85
XII.	Wilcox fish guano,	16.90	55.46	–	–	7.72
XIII.	English hay,	6 40	8 80	32.45	49.53	2.82
XIII.	Mellen's Food refuse,	4 38	13.51	18.24	59.64	4 23
XIV.	English hay,	6 47	8 90	31 89	49 95	2 79
XIV.	Molassine meal,	9 47	12.49	7 79	69 65	.60
XIV.	Waste Sheep I.,	13 60	11 33	16 54	57 08	1.45
XIV.	Brook Farm hay,	6.32	8 90	32 12	50 53	2 13

Composition of Feces (Per Cent.).

[Dry Matter.]

Sheep I.

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay,	9.73	11.37	26.53	48.35	4 02
II.	Corn meal,	9.33	12 47	25 89	48.16	4 15
VIII.	Brook Farm hay,	9.04	11.62	26.31	49.73	3.30
X.	Gloucester fish meal,	15 30	17.46	21 67	42.17	3.40
XII.	Wilcox fish guano,	14.34	14.74	23 29	44.29	3.34
XIV.	Molassine meal,	11.48	13 22	24 80	47.32	3.18

Composition of Feces (Per Cent.) — Concluded.

[Dry Matter.]

Sheep II.

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay,	9.83	10.60	27.48	48.08	4.01
II.	Corn meal,	10.12	11.68	26.73	47.08	4.39
VIII.	Brook Farm hay,	8.57	9.87	28.59	49.88	3.09
X.	Gloucester fish meal,	16.92	18.35	20.29	40.71	3.73
XII.	Wilcox fish guano,	15.36	16.41	21.36	43.30	3.57

Sheep V.

IX.	CXX Feed, Postum Cereal refuse.	8.38	17.47	28.78	42 22	3.15
XI.	Molassine meal,	8.76	12.64	26 74	48 06	3.80
XIII.	Mellen's Food refuse,	10.32	10.99	27.60	47.81	3.28
XIV.	Brook Farm hay,	9.64	10.21	30.07	47.02	3.06

Sheep VI.

IX.	CXX Feed, Postum Cereal refuse.	8.36	16.76	29.35	42.54	2.99
XI.	Molassine meal,	9.03	12.54	26.70	48 13	3.60
XIII.	Mellen's Food refuse,	10.54	11.69	25.81	48 84	3.12

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Air-dry Feces (Per Cent.).

Sheep I.

Period.	English Hay.	Corn Meal.	Brook Farm Hay.	Gloucester Fish Meal.	Wilcox Fish Guano.	Molassine Meal.	CXX Feed.	Mellen's Food Refuse.	Waste.	Feces.
I.	88 62	-	-	-	-	-	-	-	-	92.50
II.	88 32	86 55	-	-	-	-	-	-	-	93.02
VIII.	-	-	88.97	-	-	-	-	-	90.12	95.52
X.	90.75	88 36	-	94 28	-	-	-	-	-	93.52
XII.	89 25	87.57	-	-	91.62	-	-	-	-	93.09
XIV.	89 60	-	-	-	-	80.81	-	-	74.76	92.20

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Air-dry Feces (Per Cent.) — Concluded.

Sheep II.

Period.	English Hay.	Corn Meal.	Brook Farm Hay.	Gloucester Fish Meal.	Wilcox Fish Guano.	Molassine Meal.	CXX Feed.	Mellen's Food Refuse.	Waste.	Feces.
I.	88.62	-	-	-	-	-	-	-	-	92.75
II.	88.32	86.55	-	-	-	-	-	-	-	93.31
VIII.	-	-	88.97	-	-	-	-	-	90.12	95.45
X.	90.75	88.36	-	94.28	-	-	-	-	-	93.32
XII.	89.25	87.57	-	-	91.62	-	-	-	-	93.18
					Sheep V.					
IX.	90.07	-	-	-	-	-	90.82	-	-	93.63
XI.	89.82	-	-	-	-	81.94	-	-	-	94.08
XIII.	90.00	-	-	-	-	-	-	93.02	-	94.18
XIV.	-	-	89.85	-	-	-	-	-	-	92.93
					Sheep VI.					
IX.	90.07	-	-	-	-	-	90.82	-	-	93.71
XI.	89.82	-	-	-	-	81.94	-	-	-	94.04
XIII.	90.00	-	-	-	-	-	-	93.02	-	93.99

Average Daily Amount of Manure excreted and Water drunk (Grams).

Sheep I.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
I.	English hay,	648	25.83	2,586
II.	Corn meal,	426	21.02	1,660
VIII.	Brook Farm hay,	781	25.46	2,235
X.	Gloucester fish meal,	658	27.16	3,860
XII.	Wilcox fish guano,	538	24.41	2,965
XIV.	Molassine meal,	712	26.55	2,926
	Sheep II.			
I.	English hay,	584	27.05	2,413
II.	Corn meal,	497	22.79	2,126
VIII.	Brook Farm hay,	789	27.96	2,668
X.	Gloucester fish meal,	537	24 33	3,596
XII.	Wilcox fish guano,	694	25.02	3,248

Average Daily Amount of Manure excreted and Water drunk (Grams) — Concluded.

Sheep V.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
IX.	CXX Feed, Postum Cereal refuse,	827	31.68	1,696
XI.	Molassine meal,	549	24 20	1,848
XIII.	Mellen's Food refuse,	778	29.72	2,238
XIV.	Brook Farm hay,	752	30.95	3,051

Sheep VI.

IX.	CXX Feed, Postum Cereal refuse,	772	33.02	2,915
XI.	Molassine meal,	684	26.88	3,351
XIII.	Mellen's Food refuse,	946	31.26	3,801

Weights of Animals for Two Days at Beginning and Two Days at the End of Period (Pounds).

Sheep I.

Period.	Character of Food or Ration.	Beginning.		End.	
		First Weight.	Second Weight.	First Weight.	Second Weight.
I.	English hay,	143.00	143 00	145.50	144.75
II.	Corn meal,	140.00	139.50	140.75	141.00
VIII.	Brook Farm hay,	134 50	135.00	136.25	136.00
X.	Gloucester fish meal,	131.50	134.50	136.00	136.00
XII.	Wilcox fish guano,	138.75	138.25	140.25	140.25
XIV.	Molassine meal,	136.00	135.00	135.75	135.25

Sheep II.

I.	English hay,	142.50	142.50	141.50	141.50
II.	Corn meal,	137.75	137.50	136.00	136.00
VIII.	Brook Farm hay,	135.75	136.00	135.25	135.00
X.	Gloucester fish meal,	135.25	135.75	137.00	137.50
XII.	Wilcox fish guano,	139.00	139.00	138.25	139.00

Weights of Animals for Two Days at Beginning and Two Days at the End of Period (Pounds) — Concluded.

Sheep V.

Period.	Character of Food or Ration.	Beginning.		End.	
		First Weight.	Second Weight.	First Weight.	Second Weight.
IX.	CXX Feed, Postum Cereal refuse, . .	166.25	166.50	163.00	163.00
XI.	Molassine meal, ...	160.25	160.25	157.50	157.75
XIII.	Mellen's Food refuse, ...	168.50	168.50	158.50	158.75
XIV.	Brook Farm hay, ...	156.75	156.00	160.75	157.75

Sheep VI.

Period.	Character of Food or Ration.	First Weight.	Second Weight.	First Weight.	Second Weight.
IX.	CXX feed, Postum Cereal refuse, . .	158.25	159.25	157.25	156.25
XI.	Molassine meal, ...	154.00	154.00	155.75	154.75
XIII.	Mellen's Food refuse, ...	155.00	155.00	154.75	153.75

English Hay, Period I.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed, . . .	708.96	34.74	69.12	223.04	361.22	20.84
258.27 grams manure excreted, . .	238.90	23 24	27.16	63.38	115.52	9.60
Grams digested, ...	470.06	11.50	41.96	159.66	245.70	11.24
Per cent. digested, ...	66.30	33.10	60.42	71.58	68.02	53.93

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed, . . .	708.96	34.74	69.12	223.04	361.22	20.84
270.48 grams manure excreted, . .	250.87	24.66	26.59	68.94	120.62	10.06
Grams digested, ...	458.09	10.08	42.53	154.10	240.60	10.78
Per cent. digested, ...	64.61	29.02	61.53	69.09	66.61	51.73
Average per cent. for both sheep, .	65.46	31.06	60.98	70.34	67.32	52.83

Average nutritive ratio of rations for both sheep, 1:10.0.

English Hay, Corn Meal, Period II.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams English hay fed,	574.08	33.18	54.88	180.72	289.63	15.67
125 grams corn meal fed,	108.19	1.50	11.62	3.00	86.63	5.44
Amount consumed,	682.27	34.68	66.50	183.72	376.26	21.11
210.20 grams manure excreted,	195.53	18.24	24.38	50.62	94.18	8.11
Grams digested,	486.74	16.44	42.12	133.10	282.08	13.00
Per cent. digested,	71.34	47.40	63.34	72.45	74.97	61.58

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	682 27	34.68	66.50	183.72	376.26	21.11
227.87 grams manure excreted,	212.63	21.52	24.84	56.83	100.11	9.33
Grams digested,	469.64	13.16	41.66	126.89	276.15	11.78
Per cent. digested,	68 83	37.95	62.65	69.07	73.39	55.80
Average per cent. for both sheep,	70.09	42.68	63.00	70.76	74.18	58.69

Average nutritive ratio of rations for both sheep, 1:11.6.

Brook Farm Hay, Period VIII.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams Brook Farm hay fed,	711.76	45.98	58.86	241 22	350.97	14.73
87.43 grams waste,	78 79	3.69	3.59	30.01	40.66	.84
Amount consumed,	632.97	42.29	55 27	211.21	310.31	13.89
254.57 grams manure excreted,	242 40	21.91	28.17	63.78	120.54	8.00
Brook Farm hay digested,	390.57	20.38	27.10	147.43	189.77	5 89
Per cent. digested,	61.70	48.19	49.03	69.80	61.15	42.40

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams Brook Farm hay fed,	711.76	45.98	58.86	241 22	350.97	14 73
77.14 grams waste,	69 55	4 24	5 06	23.27	35.80	1.18
Amount consumed,	642.21	41.74	53.80	217.95	315.17	13.55
279.58 grams manure excreted,	266.86	22 87	26 34	76 30	133.10	8.25
Brook Farm hay digested,	375.35	18.87	27.46	141.65	182.07	5.30
Per cent. digested,	58 45	45 21	51 04	64.99	57 77	39.11
Average per cent. for both sheep,	60 08	46.70	50.04	67 40	59.96	40.76

Average nutritive ratio of rations for both sheep, 1:12.5.

CXX Feed, Postum Cereal Refuse, Period IX.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	495.39	32.35	46.32	159.02	243.38	14.32
250 grams CXX Feed fed,	227.05	6.22	44.43	41.12	128.20	7.08
Amount consumed,	722.44	38.57	90.75	200.14	371.58	21.40
316.80 grams manure excreted,	296.62	24.86	51.82	85.37	125.23	9.34
Grams digested,	425.82	13.71	38.93	114.77	246.35	12.06
Minus hay digested,	322.00	14.88	30.11	106.54	163.06	6.59
CXX Feed digested,	103.82	-	8.82	8.23	83.29	5.47
Per cent. digested,	45.73	-	19.85	20.01	64.97	77.26

Sheep VI.

Amount consumed as above,	722.44	38.57	90.75	200.14	371.58	21.40
330.20 grams manure excreted,	309.43	25.87	51.86	90.82	131.63	9.25
Grams digested,	413.01	12.70	38.89	109.32	239.95	12.15
Minus hay digested,	322.00	14.88	30.11	106.54	163.06	6.59
CXX Feed digested,	91.01	-	8.78	2.78	76.89	5.56
Per cent. digested,	40.08	-	19.76	6.76	59.98	78.53
Average per cent. for both sheep,	42.91	-	19.81	13.39	62.48	77.90

Average nutritive ratio of rations for both sheep, 1:9.8.

Gloucester Fish Meal, Period X.

Sheep I.

650 grams English hay fed,	589.88	37.81	57.81	187.82	290.87	15.57
125 grams corn meal fed,	110.45	1.61	12.07	2.87	88.53	5.37
100 grams Gloucester fish meal fed,	94.28	22.64	68.98	-	-	2.66
Amount consumed,	794.61	62.06	138.86	190.69	379.40	23.60
271.60 grams manure excreted,	254.00	38.86	44.35	55.04	107.11	8.64
Grams digested,	540.61	23.20	94.51	135.65	272.29	14.96
Minus hay and corn meal digested,	490.23	16.95	44.02	135.39	280.76	12.35
Gloucester fish meal digested,	50.38	6.25	50.49	.26	-	2.61
Per cent. digested,	53.44	27.61	73.20	-	-	98.12

Gloucester Fish Meal, Period X — Concluded.

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	794 61	62.06	138.86	190.69	379.40	23.60
243.33 grams manure excreted,	227 08	38 42	41 67	46.07	92.45	8.47
Grams digested,	567.53	23.64	97.19	144.62	286.95	15.13
Minus hay and corn meal digested,	490 23	16 95	44.02	135 39	280 76	12.35
Gloucester fish meal digested,	77 30	6 69	53.17	9.23	6.19	2.78
Per cent. digested,	81 99	29 55	77.08	-	-	104.51
Average per cent. for both sheep,	67.72	28.58	75.14	-	-	101.32

Average nutritive ratio of rations for both sheep, 1:5.2.

Molassine Meal, Period XI.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	494 01	33.20	48.02	156.35	243.65	12.79
200 grams Molassine meal fed,	163 88	15 40	17.72	12.36	117.53	.87
Amount consumed,	657.89	48.60	65.74	168.71	361.18	13.66
241.96 grams manure excreted,	227 64	19 94	28.77	60.87	109.41	8.65
Grams digested,	430 25	28.66	36.97	107 84	251.77	5.01
Minus hay digested,	321 11	15 27	31 21	104 75	163 25	5.88
Molassine meal digested,	109 14	13 39	5.76	3.09	88.52	-
Per cent. digested,	66 60	86.95	32.51	25.00	75.32	-

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed,	538 92	36.22	52.38	170.57	265.79	13.96
200 grams Molassine meal fed,	163.88	15 40	17.72	12.36	117.53	.87
Amount consumed,	702.80	51 62	70.10	182.93	383.32	14.83
268.78 grams manure excreted,	252 76	22.82	31.70	67.49	121.65	9.10
Grams digested,	450.04	28 80	38.40	115.44	261.67	5.73
Minus hay digested,	350.30	16 66	34.05	142.82	178.08	6.42
Molassine meal digested,	99.74	12.14	4.35	-	83.59	-
Per cent. digested,	60.86	78.83	24 55	-	71.12	-
Average per cent. for both sheep,	63.73	82.89	28.53	-	73.22	-

Average nutritive ratio of rations for both sheep, 1:9.4.

Wilcox Fish Guano, Period XII.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams English hay fed,	580.13	37.65	55.81	183.55	287.22	15.90
125 grams corn meal fed,	109.46	1.64	11.80	2.98	87.73	5.31
100 grams Wilcox fish guano fed,	91.62	17.36	57.42	-	-	9.30
Amount consumed,	781.21	56.65	125.03	186.53	374.95	30.51
244.11 grams manure excreted,	227.24	32.59	33.50	52.92	100.64	7.59
Grams digested,	553.97	24.06	91.53	133.61	274.31	22.92
Minus hay and corn meal digested,	482.71	16.89	42.59	132.44	277.46	12.51
Fish guano digested,	71.26	7.17	48.94	1.17	-	10.41
Per cent. digested,	77.78	41.30	85.23	-	-	111.96

Sheep II.

Amount consumed as above,	781.21	56.65	125.03	186.53	374.95	30.51
250.16 grams manure excreted,	233.10	35.80	38.25	49.79	100.94	8.32
Grams digested,	548.11	20.85	86.78	136.74	274.01	22.19
Minus hay and corn meal digested,	482.71	16.89	42.59	132.44	277.46	12.51
Fish guano digested,	65.40	3.96	44.19	4.30	-	9.68
Per cent. digested,	71.38	22.81	76.96	-	-	104.09
Average per cent. for both sheep,	74.58	32.06	81.10	-	-	108.03

Average nutritive ratio of rations for both sheep, 1:5.15.

Mellen's Food Refuse, Period XIII.

Sheep V.

550 grams English hay fed,	495.00	31.68	43.56	160.63	245.17	13.96
250 grams Mellen's Food refuse fed,	232.55	10.19	31.42	42.42	138.68	9.84
Amount consumed,	727.55	41.87	74.98	203.05	383.85	23.80
297.21 grams manure excreted,	279.91	28.89	30.76	77.26	133.82	9.18
Grams digested,	447.64	12.98	44.22	125.89	250.03	14.62
Minus hay digested,	321.75	14.57	28.31	107.62	164.26	6.42
Grams Mellen's Food refuse digested,	125.89	-	15.91	18.17	85.77	8.20
Per cent. digested,	54.13	-	50.64	42.83	61.85	83.33

Mellen's Food Refuse, Period XIII — Concluded.

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	727.55	41.87	74.98	203.05	383.85	23.80
312.56 grams manure excreted,	293.78	30.96	34.34	75.82	143.49	9.17
Grams digested,	433.77	10.91	40.64	127.23	240.36	14.63
Minus hay digested,	321.75	14.57	28.31	107.62	164.26	6.42
Grams Mellen's Food refuse digested,	112.02	-	12.33	19.61	76.10	8.21
Per cent. digested,	48.17	-	39.24	46.23	54.87	83.43
Average per cent. for both sheep,	51.15	-	44.94	44.53	58.36	83.38

Average nutritive ratio of rations for both sheep, 1:9.52.

Molassine Meal, Period XIV.

Sheep I.

600 grams English hay fed,	537.60	34.78	47.85	171.44	268.53	15.00
200 grams Molassine meal fed,	161.62	15.31	20.19	12.59	112.56	.97
Amount fed,	699.22	50.09	68.04	184.03	381.09	15.97
11.95 grams waste,	8.93	1.21	1.01	1.48	5.10	.13
Amount consumed,	690.29	48.88	67.03	182.55	375.99	15.84
265.45 grams manure excreted,	244.74	28.10	32.35	60.70	115.81	7.78
Grams digested,	445.55	20.78	34.68	121.85	260.18	8.06
Minus hay digested,	349.44	10.78	29.19	120.01	179.92	7.95
Molassine meal digested,	96.11	10.00	5.49	1.84	80.26	.11
Per cent. digested,	59.47	65.31	27.19	14.61	71.30	11.34

Average nutritive ratio of ration, 1:11.5.

Brook Farm Hay, Period XIV.

Sheep V.

750 grams Brook Farm hay fed,	669.38	42.30	59.57	215.00	318.25	14.26
309.50 grams manure excreted,	287.62	27.73	29.37	86.49	135.23	8.80
Grams digested,	381.76	14.57	30.20	128.51	183.02	5.46
Per cent. digested,	57.03	34.44	50.70	59.77	57.51	38.29

Average nutritive ratio of ration, 1:10.7.

4. Series XIX.

Digestion Coefficients of Basal Ration used in this Series.

	English Hay.	English Hay and Gluten Feed.
Dry matter,	65	66
Ash,	46	31
Protein,	65	68
Fiber,	67	66
Nitrogen-free extract,	67	70
Fat,	46	56

Composition of Feedstuffs (Per Cent.).

[Dry Matter.]

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	English hay,	6.19	10.01	30.58	50.63	2.59
I.	Gluten feed,	1.10	27.75	8.78	58.00	4.37
I.	Molassine meal,	8.63	11.29	11.09	68.26	.73
II.	English hay,	5.83	9.52	31.40	50.98	2.27
II.	Gluten feed,	1.05	27.84	8.75	57.78	4.58

Composition of Feces (Per Cent.).

[Dry Matter.]

Sheep V.

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	Molassine meal,	8.82	12.68	28.90	46.58	3.02
II.	English hay and gluten feed,	9.25	12.79	27.62	46.75	3.59

Sheep VI.

Period.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	Molassine meal,	8.65	12.57	27.34	48.27	3.17
II.	English hay and gluten feed,	10.47	12.62	26.49	46.81	3.61

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Air-dry Feces (Per Cent.).

Sheep V.

Period.	English Hay.	Gluten Feed.	Molassine Meal.	Feces.
I.,	86.45	89.78	83.41	90.92
II.,	88.02	89.55	-	92.47

Sheep VI.

Period.	English Hay.	Gluten Feed.	Molassine Meal.	Feces.
I.,	86.45	89.78	83.41	90.88
II.,	88.02	89.55	-	92.59

Average Daily Amount of Manure excreted and Water drunk (Grams).

Sheep V.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
I.	Molassine meal,	676	30.43	2,771
II.	English hay and gluten feed,	470	22.65	2,589

Sheep VI.

Period.	Character of Food or Ration.	Manure excreted Daily.	One-tenth Manure Air-dry.	Water drunk Daily.
I.	Molassine meal,	627	29.35	1,899
II.	English hay and gluten feed,	465	22.30	1,183

Weights of Animals for Two Days at Beginning and Two Days at End of Period (Pounds).

Sheep V.

Period.	Character of Food or Ration.	Beginning.		End.	
		First Weight.	Second Weight.	First Weight.	Second Weight.
I.	Molassine meal,	133.25	131.75	131.50	132.25
II.	English hay and gluten feed,	132.75	131.50	129.75	130.00

Sheep VI.

Period.	Character of Food or Ration.	Beginning.		End.	
		First Weight.	Second Weight.	First Weight.	Second Weight.
I.	Molassine meal,	156.75	157.50	159.50	-
II.	English hay and gluten feed,	157.25	158.50	155.25	152.75

Molassine Meal, Period I.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	475.48	29.43	47.60	145.40	240.74	12.31
150 grams gluten feed fed,	134.67	1.48	37.37	11.82	78.11	5.89
200 grams Molassine meal fed,	166.82	14.40	18.83	18.50	113.87	1.22
Amount consumed,	776.97	45.31	103.80	175.72	432.72	19.42
304.25 grams manure excreted,	276.62	24.40	35.08	79.94	128.85	8.35
Grams digested,	500.35	20.91	68.72	95.78	303.87	11.07
Minus English hay and gluten feed digested.	402.70	9.58	57.78	103.77	223.20	10.19
Molassine meal digested,	97.65	11.33	10.94	–	80.67	.88
Per cent. digested,	58.54	78.47	58.10	–	70.84	72.13

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	776.97	45.31	103.80	175.72	432.72	19.42
293.54 grams manure excreted,	266.77	23.08	33.53	72.93	128.77	8.46
Grams digested,	510.20	22.23	70.27	102.79	303.95	10.96
Minus English hay and gluten feed digested.	402.70	9.58	57.78	103.77	223.20	10.19
Molassine meal digested,	107.50	12.65	12.49	–	80.75	.77
Per cent. digested,	64.44	87.85	66.33	–	70.91	63.11
Average per cent. for both sheep,	61.49	83.16	62.22	–	70.88	67.62

Average nutritive ratio of rations for both sheep, 1:6.15.

English Hay, Gluten Feed, Period II.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	484.11	28.22	46.09	152.01	246.80	10.99
150 grams gluten feed fed,	134.33	1.41	37.40	11.75	77.62	6.15
Amount consumed,	618.44	29.63	83.49	163.76	324.42	17.14
226.53 grams manure excreted,	209.47	19.38	26.79	57.86	97.92	7.52
Grams digested,	408.97	10.25	56.70	105.90	226.50	9.62
Per cent. digested,	66.13	34.59	67.91	64.67	69.82	56.13

Sheep VI.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	618.44	29.63	83.49	163.76	324.42	17.14
223.00 grams manure excreted,	206.48	21.62	26.06	54.70	96.65	7.45
Grams digested,	411.96	8.01	57.43	109.06	227.77	9.69
Per cent. digested,	66.61	27.03	68.79	66.60	70.21	56.53
Average per cent. for both sheep,	66.37	30.81	68.35	65.64	70.02	56.33

Average nutritive ratio of rations for both sheep, 1:6.23.

5. Discussion of Results.

Owing to the fact that a number of the tests were repeated in a series following, the coefficients secured for each feed in the several series are brought together and discussed below.

English Hay.

But two different lots of hay were used in all of these experiments. It consisted of mixed grasses with June grass (*Poa pratensis*) predominating; cut while in blossom, well cured and in good condition. Before feeding it was cut fine by running it through a feed cutter, and thoroughly mixed to insure uniformity through the entire lot.

Summary of Coefficients, English Hay, Series XVI., Period I.; Series XVII., Periods I. and VIII.; Series XVIII., Period I.

Lot.	Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.	I.,	1	1	62.92	32.24	54.53	69.00	65.85	54.06
	II.,	1	1	59.36	27.27	52.79	62.91	63.51	54.68
	V.,	1	1	61.39	31.98	53.98	66.67	64.62	48.25
	VI.,	1	1	63.03	35.61	56.42	68.98	65.50	47.48
	Average,	1	4	61.68	31.78	54.43	66.89	64.87	51.12
II.	I.,	1	1	66.30	33.10	60.42	71.58	68.02	53.93
	II.,	1	1	64.61	29.02	61.53	69.09	66.61	51.73
	V.,	1	1	64.22	47.52	64.46	66.37	66.00	48.83
	VI.,	1	1	65.41	44.08	64.88	68.36	67.93	42.70
	Average,	1	4	65.14	38.43	62.82	68.85	67.14	49.30
	Average of all trials of similar hay for comparison.	21	73	61.00	47.00	57.00	62.00	62.00	50.00

The first lot of hay was somewhat less digestible than was the second lot, probably due to the stage of growth at time of cutting. The digestion coefficients compare quite closely with those obtained in previous experiments with similar hay.

Dried Beet Pulp and Molasses Dried Beet Pulp.

Both of these products are the dried residue from the manufacture of sugar from the sugar beet. Molasses dried beet pulp differs from the plain dried beet pulp in containing a considerable proportion of the residual molasses, probably about 25 per cent. The first-named product is noticeably darker in color.

Summary of Coefficients, Dried Beet Pulp, Series XVI., Period III.; Series XVII., Period V.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.,	1	1	76.72	32.56	49.97	83.56	90.00	-
II.,	1	1	71.45	18.59	55.47	67.03	86.84	-
III.,	1	1	75.56	-	50.14	99.76	73.59	-
Average,	1	3	74.58	-	51.86	83.45	83.48	-

Summary of Coefficients, Molasses Dried Beet Pulp, Series XVI., Period II.; Series XVII., Period V.

I.,	1	1	84.64	55.96	59.87	88.63	91.02	-
II.,	1	1	79.57	36.01	50.19	77.77	89.23	-
IV.,	1	1	82.80	61.06	73.53	64.56	91.37	-
Average,	1	3	82.34	51.01	61.20	76.99	90.54	-

The digestibility of the molasses pulp was about 8 per cent. higher than that of the plain pulp, due to the molasses which is, in all probability, entirely digestible. While beet pulp contains 15 to 18 per cent. of fiber, its digestibility is much higher than that of wheat bran or ground oats, due to its soft, unlignified character. For Sheep III. in the experiment with plain beet pulp, the fiber digestibility is very high, with a corresponding depression in the digestibility of the nitrogen-free extract. It is believed that this condition is abnormal, and that the average of the coefficients for Sheep I. and II. would

be more accurate. The digestibility of the ash in the plain pulp is uncertain, due, partly at least, to the small amount present. There being only about ½ per cent. of ether extract (fat) in beet pulp, it is not possible to secure digestion coefficients for that ingredient. From the variations noted in the digestibility of the different ingredients it is evident that the several sheep differed in their ability to make use of the different nutrients.

Cocoanut Meal.

This product is the residue from the manufacture of cocoanut oil, and is used largely in European countries. It contains about 20 per cent. of protein and 8 to 10 per cent. of fat and some 9 to 10 per cent. of fiber. The sample used was purchased from the Edible Oils Company of New York.

Summary of Coefficients, Cocoanut Meal, Series XVII., Periods II. and VII.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
V.,	1	1	78.34	63.63	89.59	-	84.59	102.41
VI.,	1	2	83.74	64.24	89.92	23.36	88.56	102.91
Average,	1	3	81.94	64.04	89.81	-	87.24	102.74
European results,[1]	3	5	80.00[2]	-	78.00	63.00	83.00	97.00

[1] Kellner's tabulation. [2] Organic matter.

This material shows a somewhat higher digestibility than the average of European trials, due partly to its less fiber content.

The digestibility of the fiber varied to such an extent as to warrant the elimination of the fiber coefficient, Sheep V. showing a slightly negative result, and the two trials with Sheep VI. showing 7.01 and 39.71 per cent., respectively. It seems probable that the addition of the cocoanut meal to the hay improved the digestibility of the hay fiber, which accounts for the apparently negative or variable fiber coefficients of the cocoanut meal. The ash, protein, extract matter and fat all show a high digestibility, and indicate this material to be a valuable protein concentrate.

Cottonseed Feed Meal, Creamo Brand.

This product consists of a mixture of high-grade cottonseed meal and cottonseed hull bran, the latter being the cottonseed hull from which the lint has been removed.

Summary of Coefficients, Cottonseed Feed Meal, Creamo Brand, Series XVII., Period III.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
V.	1	1	59.30	47.20	73.57	32.31	61.35	102.97
VI.,	1	1	57.15	51.53	76.34	19.88	61.04	98.25
Average,	1	2	58.23	49.37	74.96	26.10	61.20	100.66
High-grade cottonseed meal for comparison.	4	12	79.00	84.00	84.00	35.00	78.00	94.00

The digestion coefficients in this experiment agreed closely except for fiber. The fiber coefficient was, however, low in both instances, as was to be expected because of the tough, woody character of the hull. This material contains only about three-fourths of the total digestible dry matter of cottonseed meal of good quality. Furthermore, since it contains much less digestible protein, and two and one-half times as much total fiber as genuine cottonseed meal, it is not worth more than one-half as much for animal feeding. In fact, the northern farmer cannot afford to purchase it at present prices in place of the genuine article.

Wheat Screenings.

Wheat screenings consist of the light wheat seed, weed seeds, chaff and dirt separated from the grain as it comes to the mill in preparing the wheat for the manufacture of flour. Their composition depends upon the kind of seeds predominating and upon the amount of dirt and chaff present. They necessarily vary so much in composition that no general statement as to their nutritive value can be made, and the figures reported below should not be understood as applying to all wheat screen-

ings. The two lots used in the present experiments were quite similar in appearance and chemical composition, and were free from an excessive amount of straw and chaff. In the first sample the following seeds and ingredients were identified: light oats, oat hulls, wheat, wheat refuse, smutted grain, yellow foxtail, green foxtail, corn cockle, bindweed, flax, lady's-thumb, charlock, wild mustard, rape, lamb's-quarters, large smartweed, chaff of various sorts, wild sunflower, pigweed, timothy, shepherd's-purse, chess, oat grass, wild oats, rye and corn, together with a few unidentified seeds. Screenings are found in the eastern markets principally as an ingredient of molasses feeds. Both lots were coarsely ground before feeding.

Summary of Coefficients, Wheat Screenings, Series XVII., Period IV. (Lot I.).

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
V.,	1	1	57.57	27.36	78.88	-	63.76	86.18
VI.,	1	1	60.65	26.10	82.97	-	65.33	87.41
Average,	1	2	59.11	26.73	80.93	-	64.55	86.80

Summary of Coefficients, Wheat Screenings, Series XVII., Period X. (Lot II.).

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
V.,	1	1	64.93	-	62.26	-	79.54	87.67
VI.,	1	1	68.58	-	63.01	-	84.12	92.50
Average,	1	2	66.76	-	62.64	-	81.83	90.09
Average for both trials,	2	4	62.94	-	71.79	-	73.19	88.45

The difference shown in the digestibility of the two lots can probably be accounted for by the fact that the first lot contained more fiber and less nitrogen-free extract than did the second. In both trials the fiber coefficient showed that slightly less fiber was digested than when the hay was fed alone, indicating somewhat of a depressing effect of the wheat screenings upon fiber digestibility, and also that the fiber contained in the screenings was of decidedly inferior character. The screenings

contain a high ash content, but the small amount digested shows it to be of comparatively little value.

The experiment indicates that screenings, when finely ground and reasonably free from dirt, chaff and noxious seeds, possess considerable nutritive value. It is likely to be found primarily in the protein and extract matter of the screenings.

Flax Shives.

Flax shives, sometimes incorrectly called flax bran, consists of the ground refuse stalks and pods of the flax plant. It is found on the market as a component of some molasses and stock feeds.

Summary of Coefficients, Flax Shives, Series XVII., Period VI.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
V.,	1	1	42.94	21.86	79.98	22.00	41.27	92.26
VI.,	1	1	47.82	23.69	82.08	29.58	45.63	93.09
Average,	1	2	45.38	22.78	81.03	25.79	43.45	92.68

This experiment showed flax shives to have a digestibility of about 45 per cent. as compared with 66 per cent. for wheat bran. It contained nearly 35 per cent. of fiber of which about one-fourth proved digestible, and must be pronounced as distinctly inferior for feeding.

Cocoa Shells.

Cocoa shells are the hard, outside coating or bran of the cocoa bean. Up to the present time they have been used but little as a feedstuff, although their chemical composition would indicate that they have considerable feeding value. Preliminary feeding experiments have shown them to be rather unpalatable.

Summary of Coefficients, Cocoa Shells, Series XVII., Period IX.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.,	1	1	56.55	13.04	4.41	41.41	75.75	100.44
II.,	1	1	58.59	14.32	18.52	59.91	71.16	100.54
Average,	1	2	57.52	13.64	11.47	50.66	73.46	100.48

The coefficients for both sheep agree closely except for protein. In both cases, however, the protein coefficient is extremely low, due, perhaps, to the presence of considerable vegetable alkaloid. It is doubtful if they have more than one-half the value of corn meal. Their use will be more fully discussed elsewhere.

Brook Farm Hay.

This hay was purchased at the Brook Farm, just north of the station grounds, and consisted of a mixture of timothy, red top and clover in good condition. Sheep I. and II. left a considerable portion, Sheep I. refusing the finer portion and Sheep II. the coarser part. In a later trial Sheep V. was induced to eat the entire ration. It was used in connection with a feeding experiment.

Summary of Coefficients, Brook Farm Hay, Series XVIII., Periods VIII. and XIV.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.,	1	1	61.70	48.19	49.03	69.80	61.15	42.40
II.,	1	1	58.45	45.21	51.40	64.99	57.77	39.11
V.,	1	1	57.03	34.44	50.70	59.77	57.51	38.29
Average,	1	3	59.06	42.61	50.38	64.85	58.81	39.93
Average all trials, mixed hay for comparison.	5	10	55.00	30.00	47.00	65.00	59.00	45.00

The experiment shows this particular lot of hay to compare favorably with all previous trials of mixed hay composed of similar grasses.

CXX Feed.

This feed is a product from the Postum Cereal Company's works, and is probably the residue from the manufacture of Instant Postum, prepared by roasting a mixture of wheat, wheat bran and molasses.

Summary of Coefficients, CXX Feed, Series XVIII., Period IX.

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
V.,	1	1	45.73	-	19.85	20.00	64.97	77.26
VI.,	1	1	40.08	-	19.76	6.76	59.98	78.53
Average,	1	2	42.91	-	19.81	13.39	62.48	77.90

The results of the experiment show the CXX Feed to have a very low digestibility, probably due to the roasting that the product undergoes. The protein and fiber appear to be of little nutritive value, and the material as a whole must be pronounced quite inferior for feeding purposes.

Fish Meals.

Two varieties of fish meal were used in these experiments. The first, Gloucester fish meal, was received from the Russia Cement Company, and is a by-product from the manufacture of fish glue. The second is a by-product from the menhaden fisheries, and up to the present time has been used almost entirely as a fertilizer. It had not been treated with sulphuric acid. The fish guano contained more fat and less ash and protein than did the Gloucester fish meal. In some European countries dried fish and even the raw refuse is used as a food for domestic animals.

Summary of Coefficients, Gloucester Fish Meal, Series XVIII., Period X.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.,	1	1	53.44	27.61	73.20	-	-	98.12
II.,	1	1	81.99	29.55	77.08	-	-	104.51
Average,	1	2	67.72	28.58	75.14	-	-	101.32

Summary of Coefficients, Wilcox Fish Guano, Series XVIII., Period XII.

I.,	1	1	77.78	41.30	85.23	-	-	111.96
II.,	1	1	71.38	22.81	76.96	-	-	104.09
Average,	1	2	74.58	32.06	81.10	-	-	108.03

The nutritive ratio of the basal ration of hay and corn meal was as 1:10. It would have been better had the basal ration consisted of hay and some nitrogenous concentrate with a ratio of 1:7 or thereabouts, for it is well known that a highly nitrogenous concentrate added to a basal ration with a wide nutritive ratio (1:8 or above) has a tendency to improve the digestibility of the fiber and extract matter of the latter, and would indicate an apparent increase in the digestibility of the fish.

Gloucester Fish Meal. — In case of Sheep I.,[1] the addition of the fish to the basal ration did not appear to improve the digestibility of the carbohydrates, although it may have had a favorable effect upon the protein of the basal ration. In case of Sheep II. it exerted a noticeably favorable effect upon both the fiber and extract, and perhaps upon the protein of the basal ration.

Wilcox Fish Guano. — Sheep II. did not digest as much of the bone (ash) as did Sheep I. The fish seemed to exert a slightly favorable effect upon the fiber, but an adverse effect upon the extract matter. The addition of the fish did improve the digestibility of the fat in the basal ration.

[1] The coefficients with this sheep were not satisfactory.

It is intended to repeat these experiments, using a basal ration with a narrower ratio.

The two samples of fish were composed of approximately 20 per cent. ash, from 60 to 70 per cent. protein, and 3 and 10 per cent. fat, respectively. Its chief value, from a nutritive standpoint, consists in the amount of digestible protein and fat. In view of the prices usually prevailing for fish, it is doubtful if it would prove particularly economical as a food for animals in place of nitrogenous concentrates of vegetable origin.

Molassine Meal.

This is an English product now being extensively sold in Massachusetts. It is composed of from 25 to 30 per cent. of sphagnum moss and from 70 to 75 per cent. of cane or beet molasses. The moss, according to the manufacturers, comes from the upper layers of large bogs in Yorkshire, Eng. Such material, as time passes, decays and forms peat. A sample of the dried sphagnum moss was found to analyze as follows: —

	Per Cent.
Water,	11.45
Protein,	2.72
Fat,	1.18
Nitrogen-free extract,	43.82
Fiber,	39.74
Ash,	1.09

It is doubtful if the moss has any particular nutritive properties;[1] hence, the nutritive value of the feed consists in the amount of molasses present. The larger part of the crude protein found in Molassine meal exists in the form of amids.

[1] Kellner and Pfeiffer have shown that peat is without nutritive value.

Summary of Coefficients, Molassine Meal, Series XVIII., Periods XI. and XIV.; Series XIX., Period I.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
I.,[1]	1	1	59.47	65.31	27.19	14.61	71.30	11.34
V.,[2]	1	1	58.54	78.47	58.10	-	70.84	72.13
V.,[1]	1	1	66.60	86.95	32.51	25.00	75.32	-
VI.,[2]	1	1	64.44	87.85	66.33	-	70.91	63.11
VI.,[1]	1	1	60.86	78.83	24.55	-	71.12	-
Average,	1	5	61.98	79.48	41.74	-	71.90	-

[1] Fed with English hay. [2] Fed with English hay and gluten feed.

In three trials the basal ration was English hay; in two other trials English hay and gluten feed were used. Inasmuch as it contains practically no fat, and that its nitrogen is in the amido form, its chief nutritive value is to be found in the carbohydrates. On the basis of the digestibility and at the same moisture content, Molassine meal would have scarcely two-thirds of the nutritive value of corn meal.[1]

Mellen's Food Refuse.

This material is sold to a limited extent in Massachusetts and consists of the residue resulting from the manufacture of an infant food. The original ingredients used in the food are barley, malt, flour and bran.

Summary of Coefficients, Mellen's Food Refuse, Series XVIII., Period XIII.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
V.,	1	1	54.13	-	50.64	42.83	61.85	83.33
VI.,	1	1	48.17	-	39.24	46.23	54.87	83.43
Average,	1	2	51.15	-	44.94	44.53	58.36	83.38

[1] See also Bulletin 146, p. 58.

Mellen's Food refuse shows a total digestibility only of about 51 per cent., which is lower than would be obtained for any of the ingredients used in the manufacture of the food. This is due, no doubt, to the fact that the more digestible parts are to be found in the food itself.

Complete Summary of All Coefficients (Per Cent.).

Food.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
English hay, Series XVI. and part of Series XVII.	I.,	62.92	32.24	54.53	69.00	65.85	54.06
	II.,	59.36	27.27	52.79	62.91	63.51	54.68
	V.,	61.39	31.98	53.98	66.67	64.62	48.25
	VI.,	63.03	35.61	56.42	68.98	65.50	47.48
Average,	.	61.68	31.78	54.43	66.89	64.87	51.12
English hay, part of Series XVII., Series XVIII. and XIX.	I.,	66.30	33.10	60.42	71.58	68.02	53.93
	II.,	64.61	29.02	61.53	69.09	66.61	51.73
	V.,	64.22	47.52	64.46	66.37	66.00	48.83
	VI.,	65.41	44.08	64.88	68.36	67.93	42.70
Average,	.	65.14	38.43	62.82	68.85	67.14	49.30
Dried beet pulp,	I.,	76.72	32.56	49.97	83.56	90.00	-
	II.,	71.45	18.59	55.47	67.03	86.84	-
	III.,	75.56	-	50.14	99.76	73.59	-
Average,	.	74.58	25.58	51.86	83.45	83.48	-
Molasses dried beet pulp,	I.,	84.64	55.96	59.87	88.63	91.02	-
	II.,	79.57	36.01	50.19	77.77	89.23	-
	IV.,	82.80	61.06	73.53	64.56	91.37	-
Average,	.	82.34	51.01	61.20	76.99	90.54	-
Cocoanut meal,	V.,	78.34	63.63	89.59	-	84.59	102.41
	VI.,	83.74	63.98	94.84	7.01	89.29	104.47
	VI.,	83.74	64.50	85.00	39.71	87.83	101.35
Average,	.	81.94	64.04	89.81	23.36	87.24	102.74
Cottonseed feed meal, Creamo brand,	V.,	59.30	47.20	74.28	32.31	61.35	102.97
	VI.,	57.15	51.53	76.34	19.88	61.04	98.25
Average,	.	58.23	49.37	75.31	26.10	61.20	100.61
Wheat screenings,	V.,	57.57	27.36	78.88	-	63.76	86.18
	VI.,	60.65	26.10	82.97	-	65.33	87.41
Average,	.	59.11	26.73	80.93	-	64.55	86.80
Wheat screenings,	V.,	64.93	-	62.26	-	79.54	87.67
	VI.,	68.58	-	63.01	-	84.12	92.50
Average,	.	66.76	-	62.64	-	81.83	90.09

Complete Summary of All Coefficients (Per Cent.) — Concluded.

Food.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Flax shives,	V.,	42.94	21.86	79.98	22.00	41.27	92.26
	VI.,	47.82	23.69	82.08	29.58	45.63	93.09
Average,		45.38	22.78	81.03	25.79	43.45	92.68
Cocoa shells,	I.,	56.55	13.04	4.41	41.41	75.75	100.41
	II.,	58.49	14.23	18.52	59.91	71.16	100.54
Average,		57.52	13.64	11.47	50.66	73.46	100.48
English hay and corn meal ($5\frac{1}{2}$ to 1),[1]	I.,	71.34	47.40	63.34	72.45	74.97	61.58
	II.,	68.83	37.95	62.65	69.07	73.39	55.80
Average,		70.09	42.68	63.00	70.76	74.18	58.69
Brook Farm hay,	I.,	61.70	48.19	49.03	69.80	61.15	42.40
	II.,	58.45	45.21	51.40	64.99	57.77	39.11
	V.,	57.03	34.44	50.70	59.77	57.51	38.29
Average,		59.06	42.61	50.38	64.85	58.81	39.93
CXX Feed, Postum Cereal refuse,	V.,	45.73	-	19.85	20.01	64.97	77.26
	VI.,	40.08	-	19.76	6.76	59.98	78.53
Average,		42.91	-	19.81	13.39	62.48	77.90
Gloucester fish meal,	I.,	53.44	27.61	73.20	-	-	98.12
	II.,	81.99	29.55	77.08	-	-	104.51
Average,		67.72	28.58	75.14	-	-	101.32
Wilcox fish guano,	I.,	77.78	41.30	85.23	-	-	111.96
	II.,	71.38	22.81	76.96	-	-	104.09
Average,		74.58	32.06	81.10	-	-	108.03
Molassine meal,	I.,	59.47	65.31	27.19	14.61	71.30	11.34
	V.,	58.54	78.47	58.10	-	70.84	72.13
	V.,	66.60	86.95	32.51	25.00	75.32	-
	VI.,	64.44	87.85	66.33	-	70.91	63.11
	VI.,	60.86	78.83	24.55	-	71.12	-
Average,		61.98	79.48	41.74	-	71.90	-
Mellen's Food refuse,	V.,	54.13	-	50.64	42.83	61.85	83.33
	VI.,	48.17	-	39.24	46.23	54.87	83.43
Average,		51.15	-	44.94	44.53	58.36	83.38
English hay and gluten feed (550 to 150 grams).	V.,	66.13	34.59	67.91	64.67	69.82	56.13
	VI.,	66.61	27.03	68.79	66.60	70.21	56.53
Average,		66.37	30.81	68.35	65.64	70.02	56.33

[1] Parts by weight.

Bulletin No. 153 June, 1914

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION

A SUMMARY

OF

METEOROLOGICAL RECORDS

FOR

TWENTY-FIVE YEARS—

1889 to 1913, inclusive

BY

J. E. OSTRANDER, Meteorologist

This bulletin gives summaries of the meteorological observations made at this station for the twenty-five-year period, 1889 to 1913, inclusive. It includes, also, records of such available and at the same time apparently reliable precipitation and temperature records as were made in Amherst previous to 1889. Most of these records were made by the late Prof. E. S. Snell of Amherst College and his daughters (1836–83), while others were made in the old State Experiment Station of which Dr. C. A. Goessmann was director (1883–88).

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

Massachusetts Agricultural Experiment Station.

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CONTENTS.

A SUMMARY OF METEOROLOGICAL RECORDS.

Location and Equipment.

The meteorological observatory is located in the tower at the southeast corner of South College, at an elevation of about 50 feet above the ground. It was equipped with a number of Draper self-recording instruments, and the records date from Jan. 1, 1889. The location is on a gravel ridge with an open exposure to the north, west and southwest, with slightly higher ground about a mile to the south and a ridge considerably higher about half a mile to the east.

The top of the tower is 72 feet above the ground, and the exposure is good in all directions. The anemometer, anemoscope, wind-pressure instrument and electrical sunshine recorder are mounted from 3 to 5 feet above the top of the tower, and the recording apparatus is in the room below. The thermometer shelter and rain gauges are on the campus about 300 feet southwest from the tower and on slightly lower ground.

The observatory is in latitude 42° 23′ 48.5″ N., longitude 72° 31′ 10″ W., and the base of the tower is 223 feet above mean low water, Boston harbor, as determined by levels connecting with those of the Boston & Maine Railroad. The standard barometer is of United States Weather Bureau pattern, reading to $\frac{1}{500}$ of an inch, and the cistern is 273½ feet above sea level. The Draper self-recording barometer is mounted 1 foot higher.

The sunshine recorder of the Draper pattern was replaced by an electrical one from Friez in 1906, and the Draper anemometer by one of United States Weather Bureau pattern at about the same time. These records are received on a triple register, which also records the rainfall. The rain gauges are about 2 feet above ground and 218 feet above sea level. A United States Weather Bureau gauge is used in determining the pre-

cipitation, and the tipping bucket electrical recording gauge in determining the time and rate.

The Draper self-registering thermometer, Weather Bureau pattern, maximum and minimum thermometers and hygrometer are in a standard shelter about 4 feet above ground and 220 feet above sea level.

On Jan. 1, 1904, the time of making observations was changed from 7 A.M., 2 P.M. and 9 P.M. to 8 A.M. and 8 P.M., so as to conform with the practice of the United States Weather Bureau. This change should be noted in comparing the dew point and relative humidity before and after that date. Other data are probably not affected by the change.

Mean Barometer.

[Readings are reduced to freezing and sea level.]

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean Annual.
1889, . .	30.11	30.24	29.84	29.80	29.92	29.96	29.91	30.01	30.00	30.05	30.04	30.14	30.00
1890, . .	30.19	30.10	29.99	30.10	29.96	29.98	30.02	30.00	30.12	29.88	30.01	30.01	30.03
1891, . .	29.96	30.04	30.10	29.92	29.98	29.92	29.99	29.96	30.11	30.03	30.12	30.08	30.02
1892, . .	29.96	30.11	29.90	29.97	29.94	29.92	29.99	30.02	30.10	29.90	29.99	30.01	29.98
1893, . .	29.95	30.11	30.06	30.09	29.90	30.06	29.97	30.00	30.06	30.13	30.12	30.12	30.05
1894, . .	30.18	30.16	30.09	30.05	30.00	30.00	30.01	30.03	30.14	30.02	30.08	30.15	30.08
1895, . .	30.05	29.92	30.00	30.12	30.10	30.17	30.03	30.02	30.10	30.08	30.19	30.15	30.08
1896, . .	30.16	29.86	29.99	30.14	29.98	29.95	29.97	29.99	30.00	30.01	30.14	30.14	30.03
1897, . .	30.04	30.06	30.04	30.04	29.92	29.90	29.94	29.94	30.09	30.12	30.03	30.04	30.01
1898, . .	29.98	30.05	30.20	29.93	29.94	29.95	30.02	29.96	30.01	30.09	30.01	29.96	30.01
1899, . .	30.11	29.98	29.94	30.04	30.00	29.98	29.93	29.98	30.02	30.19	30.01	30.03	30.02
1900, . .	30.03	29.97	29.95	29.96	29.91	29.91	29.91	29.99	30.04	30.15	29.99	30.03	29.98
1901, . .	29.95	29.79	29.90	29.97	29.88	29.95	29.93	30.02	30.03	30.08	29.93	30.03	29.96
1902, . .	30.04	29.78	29.91	29.88	29.84	29.84	29.96	29.92	30.04	30.03	30.06	30.06	29.95
1903, . .	29.91	29.98	30.20	29.87	29.94	29.94	29.88	30.00	30.10	30.00	30.01	29.97	30.00
1904, . .	30.08	30.11	30.11	29.97	30.02	30.02	29.98	30.03	30.08	30.08	29.95	30.02	30.03
1905, . .	30.08	30.12	30.12	29.85	29.93	29.93	29.95	29.98	30.05	30.10	30.01	30.08	29.94
1906, . .	30.09	30.20	30.09	29.98	29.94	29.94	29.98	30.02	30.09	30.09	30.04	30.12	30.05
1907, . .	30.23	30.09	30.08	29.88	29.93	29.93	29.87	30.00	30.02	30.05	30.05	30.02	30.02
1908, . .	29.97	30.08	30.10	29.92	30.03	30.03	30.04	30.03	30.10	30.17	30.01	30.04	30.04
1909, . .	30.15	29.96	29.82	30.06	29.94	29.97	29.91	30.02	30.11	30.03	30.16	29.89	30.01
1910, . .	30.11	30.07	30.08	29.97	29.96	29.92	29.89	30.07	30.10	30.01	29.80	30.03	30.00
1911, . .	30.12	30.12	29.99	30.14	30.03	29.94	29.99	30.02	30.06	30.11	30.01	30.15	30.06
1912, . .	30.02	29.93	30.13	29.99	29.96	29.99	29.98	29.95	30.07	30.06	30.00	30.01	30.01
1913, . .	30.10	30.01	30.11	30.02	29.99	30.00	29.94	30.03	30.13	29.97	30.13	30.01	30.04
Mean, .	30.06	30.03	30.03	29.99	29.96	29.96	29.96	30.00	30.07	30.06	30.04	30.05	30.01

Range of Barometer (in Inches).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Range Annual.
1889, . .	1.62	1.51	1.58	1.16	.75	.97	.68	.66	.98	.96	1.31	1.75	1.81
1890, . .	1.50	1.35	1.08	1.08	.81	.58	.63	1.10	.69	1.09	.98	1.20	1.76
1891, . .	1.93	1.36	1.21	1.42	.79	.53	.74	.61	.73	1.11	1.56	1.22	2.05
1892, . .	1.38	1.65	1.16	1.02	.96	.84	.97	.55	.96	.98	1.00	1.01	1.65
1893, . .	1.53	1.83	1.27	1.25	1.16	.67	.68	.93	.81	1.37	1.16	1.53	1.92
1894, . .	1.89	1.65	1.04	.86	.93	.75	.57	.44	1.11	1.19	1.22	1.23	2.01
1895, . .	1.46	1.88	1.24	1.40	.84	.66	.51	.53	.68	1.09	1.47	1.78	2.27
1896, . .	.97	1.77	1.52	.96	.75	.83	.79	.59	.85	1.10	1.23	1.57	2.22
1897, . .	1.57	1.15	1.74	1.10	.76	.55	.72	.61	.73	1.12	1.48	1.42	1.76
1898, . .	1.43	1.63	1.17	.86	.76	.95	.81	.60	.82	1.19	1.25	1.39	1.75
1899, . .	1.70	1.41	1.54	.90	.60	.59	.51	.56	.88	.76	1.10	1.58	1.82
1900, . .	1.58	1.89	1.52	1.01	.99	.67	.73	.53	1.03	1.07	1.71	1.53	1.89
1901, . .	1.68	.97	1.17	1.19	.77	.61	.59	.51	1.00	1.22	1.14	1.13	1.68
1902, . .	1.49	1.41	1.55	1.04	.94	1.27	.58	.67	.78	1.25	1.12	1.34	1.89
1903, . .	1.49	1.55	1.19	1.15	.85	.97	.57	.77	.78	1.08	1.32	1.56	1.77
1904, . .	1.50	1.36	1.58	1.00	.75	.81	.73	.73	1.20	1.23	1.84	1.43	2.23
1905, . .	1.37	1.28	.89	1.15	.85	.83	.58	.72	.66	1.16	1.22	1.53	1.64
1906, . .	1.53	1.28	1.64	1.05	1.08	.77	.90	.72	1.03	1.41	1.05	1.30	1.70
1907, . .	1.34	1.27	1.39	1.42	.67	.71	.76	.71	.91	1.24	1.59	1.46	1.79
1908, . .	1.73	1.89	1.22	1.35	1.11	.65	.66	.68	.73	1.17	1.14	1.31	1.97
1909, . .	1.64	1.63	1.52	1.14	0.82	.68	.88	.97	.80	.97	1.24	1.54	1.91
1910, . .	1.76	1.40	1.11	.90	1.02	.83	.57	.82	.57	1.05	1.02	1.44	1.76
1911, . .	1.50	1.09	1.77	1.14	.97	.69	.74	.76	.85	1.04	1.24	1.20	1.77
1912, . .	1.60	1.75	1.43	1.32	.86	.64	.89	.77	.75	.87	1.17	1.46	1.98
1913, . .	2.18	.88	1.92	1.06	.87	.80	.65	.72	.83	1.38	1.65	1.34	2.33
Mean, .	1.57	1.47	1.38	1.12	.87	.75	.70	.69	.87	1.12	1.29	1.41	1.89

Maximum Barometer.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Maximum Annual.
1889, . .	30.82	30.97	30.66	30.54	30.40	30.54	30.35	30.45	30.40	30.52	30.67	30.96	30.97
1890, . .	30.94	30.72	30.56	30.57	30.32	30.28	30.27	30.28	30.42	30.41	30.35	30.61	30.94
1891, . .	30.62	30.69	30.57	30.56	30.44	30.22	30.37	30.27	30.45	30.67	30.74	30.55	30.74
1892, . .	30.67	30.72	30.45	30.53	30.43	30.39	30.50	30.24	30.42	30.43	30.44	30.53	30.72
1893, . .	30.61	30.83	30.63	30.65	30.32	30.36	30.25	30.30	30.45	30.65	30.70	30.92	30.92
1894, . .	30.77	30.89	30.57	30.52	30.50	30.33	30.31	30.24	30.63	30.42	30.73	30.53	30.89
1895, . .	30.61	30.44	30.52	30.70	30.55	30.51	30.33	30.29	30.41	30.67	30.73	30.83	30.83
1896, . .	30.56	30.49	30.62	30.60	30.48	30.42	30.49	30.39	30.40	30.62	30.86	30.94	30.94
1897, . .	30.77	30.70	30.88	30.61	30.36	30.28	30.33	30.18	30.40	30.67	30.60	30.60	30.88
1898, . .	30.61	30.64	30.76	30.34	30.33	30.35	30.44	30.26	30.41	30.46	30.53	30.52	30.76
1899, . .	30.92	30.53	30.49	30.39	30.29	30.25	30.24	30.31	30.47	30.50	30.54	30.66	30.92
1900, . .	30.67	30.75	30.59	30.48	30.38	30.19	30.16	30.25	30.35	30.52	30.64	30.51	30.75
1901, . .	30.69	30.34	30.43	30.52	30.20	30.24	30.29	30.28	30.51	30.66	30.37	30.58	30.69
1902, . .	30.66	30.27	30.50	30.28	30.43	30.46	30.29	30.26	30.38	30.52	30.48	30.75	30.75
1903, . .	30.62	30.48	30.65	30.46	30.54	30.39	30.17	30.42	30.42	30.40	30.70	30.60	30.70
1904, . .	30.90	30.67	30.96	30.50	30.37	30.35	30.26	30.42	30.62	30.57	30.57	30.54	30.96
1905, . .	30.70	30.62	30.60	30.37	30.38	30.19	30.15	30.27	30.41	30.58	30.63	30.86	30.86
1906, . .	30.78	30.95	30.92	30.45	30.49	30.35	30.46	30.38	30.50	30.63	30.42	30.77	30.95
1907, . .	30.75	30.78	30.59	30.41	30.34	30.22	30.18	30.35	30.39	30.60	30.59	30.45	30.78
1908, . .	30.59	30.83	30.59	30.52	30.31	30.40	30.26	30.34	30.45	30.59	30.45	30.61	30.83
1909, . .	30.75	30.53	30.36	30.60	30.29	30.26	30.27	30.39	30.52	30.52	30.74	30.58	30.75
1910, . .	30.87	30.80	30.50	30.40	30.40	30.24	30.18	30.37	30.34	30.47	30.40	30.78	30.87
1911, . .	30.66	30.64	30.72	30.71	30.40	30.24	30.26	30.30	30.41	30.59	30.48	30.57	30.72
1912, . .	30.59	30.47	30.70	30.62	30.31	30.31	30.35	30.29	30.37	30.46	30.50	30.61	30.70
1913, . .	30.73	30.44	30.88	30.56	30.39	30.43	30.19	30.41	30.58	30.52	30.72	30.47	30.88
Mean, . .	30.71	30.65	30.62	30.52	30.39	30.33	30.29	30.32	30.44	30.55	30.58	30.65	30.83

Minimum Barometer.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Minimum Annual.
1889, . .	29.20	29.46	29.08	29.38	29.65	29.57	29.67	29.79	29.42	29.56	29.36	29.21	29.08
1890, . .	29.44	29.37	29.48	29.49	29.51	29.70	29.64	29.18	29.73	29.32	29.37	29.41	29.18
1891, . .	28.69	29.33	29.36	29.14	29.65	29.69	29.63	29.66	29.72	29.56	29.18	29.33	28.69
1892, . .	29.29	29.07	29.29	29.51	29.47	29.55	29.53	29.69	29.46	29.45	29.44	29.52	29.07
1893, . .	29.08	29.00	29.36	29.40	29.16	29.69	29.57	29.37	29.64	29.28	29.54	29.39	29.00
1894, . .	28.88	29.24	29.53	29.66	29.57	29.58	29.74	29.80	29.52	29.23	29.51	29.30	28.88
1895, . .	29.17	28.56	29.28	29.30	29.71	29.85	29.82	29.76	29.73	29.58	29.26	29.05	28.56
1896, . .	29.59	28.72	29.10	29.64	29.73	29.59	29.70	29.80	29.55	29.52	29.63	29.37	28.72
1897, . .	29.20	29.55	29.14	29.51	29.60	29.63	29.61	29.57	29.67	29.55	29.12	29.18	29.12
1898, . .	29.18	29.01	29.59	29.48	29.57	29.40	29.63	29.66	29.59	29.27	29.28	29.13	29.01
1899, . .	29.22	29.12	28.95	29.49	29.69	29.66	29.63	29.75	29.56	29.74	29.44	29.10	29.10
1900, . .	29.08	28.86	29.06	29.47	29.39	29.51	29.42	29.72	29.32	29.42	28.93	28.98	28.86
1901, . .	29.01	29.37	29.26	29.33	29.43	29.63	29.70	29.76	29.51	29.44	29.23	29.42	29.01
1902, . .	29.17	28.86	28.95	29.24	29.49	29.24	29.61	29.59	29.60	29.27	29.36	29.41	28.86
1903, . .	29.13	28.93	29.46	29.31	29.69	29.42	29.60	29.65	29.69	29.32	29.38	29.04	28.93
1904, . .	29.40	29.31	29.38	29.50	29.62	29.54	29.53	29.69	29.42	29.28	28.73	29.11	28.73
1905, . .	29.33	29.34	29.71	29.22	29.53	29.36	29.57	29.55	29.75	29.42	29.41	29.33	29.22
1906, . .	29.25	29.67	29.28	29.40	29.41	29.58	29.56	29.66	29.47	29.22	29.37	29.47	29.25
1907, . .	29.41	29.51	29.29	28.99	29.69	29.51	29.42	29.64	29.48	29.36	29.00	29.05	28.99
1908, . .	28.86	28.94	29.37	29.27	29.20	29.75	29.69	29.66	29.72	29.42	29.31	29.30	28.86
1909, . .	29.11	28.90	28.84	29.46	29.47	29.58	29.39	29.42	29.72	29.55	29.50	29.04	28.84
1910, . .	29.11	29.40	29.39	29.50	29.38	29.41	29.61	29.55	29.77	29.42	29.38	29.34	29.11
1911, . .	29.16	29.55	28.95	29.57	29.43	29.55	29.52	29.54	29.56	29.55	29.24	29.37	28.95
1912, . .	28.99	28.72	29.27	29.30	29.45	29.67	29.46	29.52	29.62	29.59	29.33	29.15	28.72
1913, . .	28.55	29.56	29.26	29.50	29.52	29.63	29.54	29.69	29.75	29.14	29.07	29.13	28.55
Mean, .	29.14	29.17	29.27	29.40	29.52	29.57	29.59	29.63	29.60	29.42	29.29	29.25	28.93

Mean Hourly Temperature.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, . .	32.9	23.9	37.9	49.3	61.4	67.7	69.5	65.5	61.9	46.5	41.9	35.0	49.5
1890, . .	32.1	31.7	31.9	46.5	57.1	65.3	69.8	67.2	59.7	48.5	38.0	22.9	47.6
1891, . .	27.6	29.6	33.7	49.4	57.3	66.6	68.2	70.2	65.3	49.9	39.7	38.3	49.7
1892, . .	25.3	28.4	33.1	48.7	56.1	70.3	72.2	70.0	60.6	50.8	39.3	28.5	48.6
1893, . .	19.0	25.7	33.4	44.7	58.7	69.0	71.4	71.0	58.1	53.9	40.1	28.2	47.8
1894, . .	28.7	25.5	41.6	47.9	58.7	69.4	73.5	69.3	64.8	52.1	36.4	28.5	49.7
1895, . .	25.0	22.3	33.0	46.9	61.3	70.5	69.3	70.4	63.8	48.1	41.1	29.0	48.4
1896, . .	23.2	30.0	29.4	49.2	62.4	65.0	70.7	68.2	59.3	46.4	41.9	25.3	49.3
1897, . .	24.2	25.1	32.9	46.5	57.1	61.8	70.5	66.0	59.8	49.9	36.9	28.8	46.6
1898, . .	21.8	26.3	39.6	43.0	55.6	66.0	70.9	69.7	63.0	51.1	37.3	26.2	47.5
1899, . .	23.3	21.8	30.6	46.1	55.7	67.4	70.1	68.0	59.7	51.1	37.0	30.8	46.8
1900, . .	25.5	24.6	29.5	46.9	55.4	67.1	70.6	70.1	63.8	54.5	41.3	30.6	48.3
1901, . .	23.7	20.1	33.1	46.8	56.2	68.0	72.5	69.9	62.1	50.1	33.4	26.4	46.9
1902, . .	22.9	25.5	40.5	47.3	57.0	63.5	67.8	66.1	60.3	50.7	42.8	23.5	47.3
1903, . .	24.3	27.3	42.6	46.9	59.2	59.6	68.9	62.0	61.3	51.1	34.3	22.5	46.7
1904, . .	14.3	17.7	31.0	42.5	60.1	65.0	69.8	66.4	59.8	47.2	33.0	19.6	43.9
1905, . .	20.4	17.7	33.1	45.6	56.9	64.4	71.1	65.8	59.1	49.9	36.3	29.8	45.8
1906, . .	29.6	23.8	28.3	45.1	56.7	66.1	70.1	70.5	64.0	50.5	38.5	24.2	47.3
1907, . .	22.4	16.5	35.2	41.5	51.8	63.9	70.0	66.1	61.3	45.6	37.6	30.5	45.2
1908, . .	25.7	20.5	34.7	45.1	59.2	67.6	72.5	66.6	62.9	51.3	38.0	27.1	47.6
1909, . .	25.7	28.1	32.4	44.4	55.5	66.4	68.7	66.5	60.5	47.7	41.3	24.7	46.8
1910, . .	25.5	23.9	39.1	50.6	56.1	63.8	72.1	67.1	61.1	51.7	36.4	21.7	47.4
1911, . .	27.4	23.3	31.5	43.7	61.9	64.5	73.7	67.8	60.2	48.5	36.7	32.7	47.6
1912, . .	14.6	20.7	30.5	45.2	58.1	65.0	71.6	66.4	61.2	52.4	40.0	32.9	46.5
1913, . .	33.6	22.7	37.9	47.6	55.6	66.4	71.4	69.5	59.7	54.7	41.6	31.3	49.3
Mean, .	24.7	24.1	34.1	46.3	57.6	66.0	70.7	67.9	61.3	50.2	38.6	28.0	47.5

Range of Temperature (in Degrees F.).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Range Annual.
1889, . .	48.0	49.0	40.0	46.0	50.0	44.0	31.0	37.0	41.0	43.0	41.0	57.5	92.0
1890, . .	57.0	54.5	69.0	57.5	48.5	47.5	54.0	47.0	52.0	52.0	51.0	48.5	100.5
1891, . .	52.5	60.0	57.5	61.5	62.0	60.0	48.5	47.5	55.5	69.0	60.5	51.5	100.0
1892, . .	66.5	53.5	54.5	58.5	56.0	54.0	52.0	44.0	49.0	54.5	53.0	47.0	104.5
1893, . .	63.0	54.5	48.0	48.5	57.0	52.5	49.5	57.0	51.0	57.0	52.0	64.0	109.0
1894, . .	52.0	66.0	56.0	63.0	56.0	55.5	50.0	54.0	56.0	43.0	55.0	55 0	115.0
1895, . .	50.0	55.0	44.0	56.0	62.5	51.0	54.0	52.0	64.0	51.0	57.0	68.0	105.0
1896, . .	53.0	67.0	52.0	67.5	62.5	51.0	41.0	55.0	57.5	49.0	54.0	62.0	111.0
1897, . .	51.0	59.0	60.5	60.0	48.0	47.5	36.0	43.0	59.5	63.5	58.0	62.5	102.5
1898, . .	65.5	73.0	45.5	54.0	46.0	50.0	56.5	46.5	58.5	59.5	56.0	60.0	115.5
1899, . .	70.5	61.0	42.0	61.0	55.5	51.0	47.0	51.0	51.5	61.5	40.5	59.0	114.5
1900, . .	56.0	64.0	46.0	59.0	67.5	54.0	51.0	53.0	53.5	61.0	55.0	57.5	104.0
1901, . .	55.0	48.5	57.0	58.5	50.5	57.5	52.0	33.5	59.0	51.0	54.0	70.5	111.0
1902, . .	47.5	49.0	48.5	57.5	61.0	49.0	45.0	44.0	51.5	51.5	47.5	64.0	106.0
1903, . .	57.5	68.0	57.0	62.0	68.0	48.5	52.5	42.0	60.5	55.0	68.5	61.5	109.0
1904, . .	66.0	56.0	68.0	50.5	48.0	51.5	48.0	49.5	58.5	59.5	49.0	47.0	120.5
1905, . .	64.0	59.5	76.0	57.0	50.5	54.0	47.0	47.5	53.0	59.0	50.0	51.5	106.0
1906, . .	56.5	57.5	60.5	53.5	58.5	50.5	43.5	43.0	59.5	53.5	43.5	48.5	98.5
1907, . .	78.0	61.5	74.0	49.0	65.0	57.0	46.0	55.0	49.0	52.5	40.5	50.5	119.5
1908, . .	58.5	68.0	62.0	66.0	55.0	55.5	50.5	51.5	55.0	67.5	39.5	63.5	108.0
1909, . .	61.0	57.5	41.0	61.0	49.0	51.5	51.0	56.0	48.0	61.0	53.5	60.0	102.5
1910, . .	65.0	60.5	65.5	56.0	53.0	53.0	48.5	44.5	48.0	65.0	46.0	49.0	106.0
1911, . .	49.0	54.5	56.5	68.0	67.5	45.0	55.0	50.0	55.0	48.5	48.0	52 0	107.0
1912, . .	64.0	66.0	59.5	54.0	55.5	55.0	57.5	50.0	51.0	56.5	48.5	62.0	117.5
1913, . .	48.5	59.5	73.0	62.0	58.5	55.0	59.0	56.0	56.5	54.5	45.0	48.0	104.5
Mean, .	58.2	59.3	56.5	57.9	56.5	52.0	49.0	48.4	54.1	56.0	50.7	56.8	107.6

Maximum Temperatures (in Degrees F.).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Maximum Annual.
1889, . .	56.0	47.0	61.0	78.0	88.0	90.0	85.0	82.0	81.0	69.0	61.0	63.0	90.0
1890, . .	61.5	57.5	62.5	79.5	80.0	88.0	94.0	88.5	80.5	78.0	62.5	43.5	94.0
1891, . .	52.0	54.0	56.5	79.5	87.0	94.0	90.0	92.5	91.5	89.0	64.0	60.5	94.0
1892, . .	57.0	46.5	60.5	78.5	84.0	95.0	94.0	94.0	80.0	77.5	67.0	46.0	95.0
1893, . .	50.0	50.0	52.0	67.5	87.0	94.0	90.5	96.0	81.0	80.0	63.0	52.0	96.0
1894, . .	53.0	49.0	73.0	79.0	85.0	93.0	98.0	91.0	91.0	75.0	65.0	51.0	98.0
1895, . .	45.5	45.0	49.0	81.0	92.0	95.0	90.0	90.0	97.0	71.0	72.0	65.0	97.0
1896, . .	41.0	53.0	57.0	88.5	94.5	90.0	91.0	97.0	88.5	72.0	69.0	52.5	97.0
1897, . .	51.0	48.0	59.0	80.5	79.5	85.5	91.0	85.0	91.5	84.0	63.0	59.0	91.5
1898, . .	50.0	54.0	60.0	71.0	78.5	89.5	96.5	91.0	93.0	86.5	62.0	48.0	96.5
1899, . .	49.0	51.0	52.0	82.0	88.5	93.0	90.0	92.0	84.0	82.0	58.0	61.0	93.0
1900, . .	51.5	56.0	49.0	80.8	91.5	94.0	95.5	96.0	89.0	83.0	67.0	58.0	96.0
1901, . .	47.0	44.0	56.5	86.5	82.0	98.5	100.5	86.5	92.0	75.0	60.0	60.0	100.5
1902, . .	47.0	54.0	65.0	83.0	91.0	89.0	90.0	87.0	86.5	74.0	65.0	49.0	91.0
1903, . .	45.5	57.0	76.0	84.0	92.5	86.5	97.0	84.5	91.0	77.5	74.5	52.0	97.0
1904, . .	40.0	48.0	65.0	70.5	85.0	92.5	94.5	89.5	84.5	77.5	56.5	43.5	94.5
1905, . .	51.0	48.5	77.0	79.0	82.5	90.0	93.0	89.0	85.0	80.5	61.0	54.5	93.0
1906, . .	60.0	52.5	53.0	74.5	90.0	87.5	88.5	90.5	91.0	77.5	62.0	45.5	91.0
1907, . .	54.5	43.0	79.5	70.5	90.0	95.0	90.0	96.0	85.0	73.0	60.0	60.5	96.0
1908, . .	53.0	56.0	67.0	84.0	88.5	91.5	96.0	88.5	88.0	90.5	58.0	65.5	96.0
1909, . .	54.0	54.5	54.0	80.0	81.5	91.5	93.0	94.0	83.0	85.0	72.0	51.5	94.0
1910, . .	56.0	53.5	78.0	80.0	84.0	88.0	97.0	85.5	82.0	84.0	61.0	47.0	97.0
1911, . .	50.5	51.5	59.0	86.0	94.5	89.5	104.0	94.5	84.0	72.5	66.5	62.0	104.0
1912, . .	45.0	49.5	60.5	78.0	88.0	91.0	98.5	89.0	86.0	83.0	67.0	65.0	98.5
1913, . .	59.5	55.0	74.0	84.5	89.0	92.0	100.0	97.0	87.5	79.0	68.0	53.0	100.0
Mean,	51.2	51.1	62.2	79.4	87.0	91.3	93.7	90.7	86.9	79.0	64.2	54.7	95.6

Minimum Temperatures (in Degrees F.).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Minimum Annual.
1889, . .	8.0	—2.0	21.0	32.0	38.0	46.0	34.0	45.0	40.0	26.0	20.0	5.5	—2.0
1890, . .	4.5	3.0	—6.5	22.0	31.5	40.5	40.0	41.5	28.5	26.0	11.5	—5.0	—6.5
1891, . .	—0.4	—6.0	—1.0	18.0	25.0	34.0	41.5	45.0	36.0	20.0	3.5	9.0	—6.0
1892, . .	—9.5	—7.0	6.0	20.5	28.0	41.0	42.0	50.0	31.0	23.0	14.0	—1.0	—9.5
1893, . .	—13.0	—4.5	4.0	19.0	30.0	41.5	41.0	39.0	30.0	23.0	11.0	—12.0	—13.0
1894, . .	1.0	—17.0	17.0	16.0	29.0	37.5	48.0	37.0	35.0	32.0	10.0	—4.0	—17.0
1895, . .	—4.5	—10.0	5.0	25.0	29.5	44.0	46.0	38.0	33.0	20.0	15.0	—3.0	—10.0
1896, . .	—12.0	—14.0	5.0	21.0	32.0	39.0	50.0	42.0	31.0	23.0	15.0	—9.5	—14.0
1897, . .	0.0	—11.0	—1.5	20.5	31.5	38.0	55.0	42.0	32.0	20.5	5.0	—3.5	—11.0
1898, . .	—15.5	—19.0	14.5	17.0	32.5	39.5	40.0	44.5	34.5	27.0	6.0	—12.0	—19.0
1899, . .	—21.5	—10.0	10.0	21.0	33.0	42.0	43.0	41.0	32.5	20.5	17.5	2.0	—21.5
1900, . .	—4.5	—8.0	3.0	21.0	24.0	40.0	44.5	43.0	35.5	22.0	12.0	0.5	—8.0
1901, . .	—8.0	—4.5	—0.5	28.0	31.5	41.0	48.5	53.0	33.0	24.0	6.0	—10.5	—10.5
1902, . .	—0.5	5.0	16.5	25.5	30.0	40.0	45.0	43.0	35.0	22.5	17.5	—15.0	—15.0
1903, . .	—12.0	—11.0	19.0	22.0	24.5	38.0	44.5	42.5	30.5	22.5	6.0	—9.5	—12.0
1904, . .	—26.0	—8.0	—3.0	20.0	37.0	44.0	46.5	40.0	26.0	18.0	7.5	—3.5	—26.0
1905, . .	—13.0	—11.0	1.0	22.0	32.0	36.0	46.0	41.5	32.0	21.5	11.0	3.0	—13.0
1906, . .	3.5	—5.0	—7.5	21.0	31.5	37.0	45.0	47.5	31.5	24.0	18.5	—3.0	—7.5
1907, . .	—23.5	—18.5	5.5	20.5	25.0	38.0	44.0	41.0	36.0	20.5	19.5	10.0	—23.5
1908, . .	—5.5	—12.0	5.0	18.0	33.5	36.0	46.0	37.0	33.0	23.0	18.5	2.0	—12.0
1909, . .	—7.0	—3.0	13.0	19.0	32.5	40.0	42.0	38.0	35.0	24.0	18.5	—8.5	—8.5
1910, . .	—9.0	—7.0	12.5	24.0	31.0	35.0	48.5	41.0	34.0	19.0	15.0	—2.0	—9.0
1911, . .	1.5	—3.0	2.5	18.0	27.0	44.5	49.0	44.5	29.0	24.0	18.5	10.0	—3.0
1912, . .	—19.0	—16.5	1.0	24.0	32.5	36.0	41.0	39.0	35.0	26.5	18.5	3.0	—19.0
1913, . .	11.0	—4.5	1.0	22.5	30.5	37.0	41.0	41.0	31.0	24.5	23.0	5.0	—4.5
Mean, .	—7.0	—8.2	5.7	21.5	30.5	39.4	45.3	42.3	32.8	23.1	13.5	—2.9	—12.0

Mean Dew Point (in Degrees F.).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, . .	26.3	21.2	30.4	43.8	52.8	61.1	62.7	59.5	56.9	39.4	38.3	30.9	43.6
1890, . .	23.8	25.2	26.5	35.6	58.0	57.9	61.5	57.2	55.8	41.0	29.7	14.7	40.6
1891, . .	20.7	21.7	22.6	36.3	44.6	57.0	58.5	62.4	58.1	40.6	30.4	28.2	40.1
1892, . .	18.8	20.9	21.5	33.0	44.9	62.3	60.9	62.1	51.9	41.0	32.1	20.5	39.2
1893, . .	13.9	17.3	24.0	31.4	45.7	58.3	58.8	59.9	49.1	44.2	29.9	21.9	37.9
1894, . .	21.6	17.9	31.1	34.2	52.6	57.9	62.4	58.6	56.2	44.6	27.3	22.3	40.5
1895, . .	19.2	17.1	26.2	35.8	48.7	59.6	59.3	60.4	54.8	35.4	34.4	23.6	39.5
1896, . .	14.3	22.0	25.6	35.9	48.3	53.9	62.4	61.7	54.5	42.4	37.7	19.6	39.9
1897, . .	18.0	18.1	26.9	35.7	48.0	53.3	64.6	59.7	52.7	39.0	31.8	24.2	39.6
1898, . .	18.4	21.8	30.5	34.2	48.8	59.3	64.6	64.6	56.9	46.6	32.7	20.8	41.6
1899, . .	16.6	17.0	25.5	36.5	48.6	59.5	62.5	59.4	51.5	48.8	29.8	25.1	40.1
1900, . .	18.1	17.8	19.3	34.9	43.7	57.0	62.3	62.0	54.7	47.1	32.0	21.7	39.2
1901, . .	16.6	10.6	24.7	35.6	45.7	56.2	63.4	62.3	54.5	39.9	24.1	17.9	37.6
1902, . .	12.3	15.1	32.2	36.3	44.0	53.5	57.3	57.8	53.7	40.5	34.2	15.0	37.7
1903, . .	16.0	21.0	34.6	34.1	44.9	53.7	59.3	54.7	52.5	39.2	25.6	16.1	37.6
1904, . .	9.3	9.5	22.4	31.5	48.4	56.6	61.5	59.0	52.7	37.5	25.1	12.6	35.5
1905, . .	12.8	9.2	24.8	33.5	45.7	56.5	63.2	59.0	52.4	40.3	26.8	23.8	37.3
1906, . .	20.8	15.2	19.3	34.7	46.4	58.3	63.1	63.6	55.2	42.9	27.7	16.5	38.6
1907, . .	13.4	9.0	25.8	32.0	42.2	55.0	61.0	56.5	54.6	37.1	32.0	23.7	36.9
1908, . .	16.5	14.7	26.9	31.9	50.1	56.2	63.7	58.3	53.5	41.8	30.1	18.6	38.5
1909, . .	19.0	21.0	26.0	35.5	45.1	56.6	58.6	57.8	52.6	38.0	32.6	15.8	38.2
1910, . .	18.2	16.9	28.8	39.2	45.5	55.2	61.0	57.4	53.5	41.2	28.2	14.2	38.3
1911, . .	19.7	15.3	22.2	30.1	51.7	55.8	61.7	59.0	52.9	40.1	27.4	23.9	38.3
1912, . .	7.8	12.6	23.4	37.0	50.2	54.5	60.5	58.1	54.3	41.7	31.6	23.5	38.6
1913, . .	25.9	14.1	30.7	38.5	46.0	54.6	59.8	58.6	51.0	46.5	32.1	23.5	40.1
Mean, .	17.5	16.9	26.1	35.1	47.6	56.8	61.4	60.0	53.9	41.5	30.5	20.7	39.0

Mean Relative Humidity.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, . .	79.0	90.0	75.0	78.3	73.8	79.1	78.2	80.4	83.3	75.7	75.4	75.2	78.6
1890, . .	68.2	74.8	77.3	64.7	67.1	71.3	70.1	74.9	80.9	68.2	67.8	67.2	71.1
1891, . .	72.2	69.4	63.7	60.1	59.3	65.3	66.1	70.3	72.1	65.5	68.7	68.7	66.8
1892, . .	73.7	72.8	64.1	54.5	60.3	68.9	65.6	74.9	70.7	65.5	71.0	70.3	67.7
1893, . .	80.2	74.7	71.4	64.8	66.0	71.1	64.8	70.7	72.8	67.0	68.8	80.9	71.1
1894, . .	78.8	77.5	67.5	60.5	65.8	68.1	68.2	69.9	74.4	82.7	70.8	79.0	71.9
1895, . .	82.5	83.9	80.6	68.1	65.0	68.5	72.7	72.7	73.7	69.2	80.5	75.4	74.4
1896, . .	73.3	87.5	85.3	62.0	62.5	67.3	73.1	79.9	84.0	85.0	82.3	79.8	76.9
1897, . .	77.1	75.7	78.9	68.2	71.5	73.3	80.1	79.6	76.6	68.7	83.2	83.9	76.4
1898, . .	85.2	83.1	72.6	72.1	78.4	77.1	79.3	82.1	80.0	83.6	83.4	80.2	79.8
1899, . .	77.7	82.5	79.1	69.2	70.3	74.0	75.2	74.1	74.0	75.9	76.2	79.4	75.6
1900, . .	75.1	77.4	67.8	64.7	65.5	69.5	71.1	75.9	73.1	77.0	75.9	74.9	72.3
1901, . .	74.3	68.5	70.8	68.1	68.1	65.5	72.3	76.3	76.8	70.5	71.1	69.8	71.0
1902, . .	66.2	66.8	72.3	67.1	63.4	70.8	77.2	76.3	79.1	70.9	75.6	72.5	71.6
1903, . .	72.0	77.7	76.4	64.7	61.3	81.1	71.4	78.2	75.0	74.5	73.5	76.5	73.5
1904, . .	85.5	77.7	74.4	70.8	69.7	77.0	77.7	80.5	81.8	74.0	77.5	77.8	77.0
1905, . .	77.2	75.1	76.7	66.7	68.2	78.8	79.1	82.5	83.2	75.9	73.5	80.6	76.5
1906, . .	74.8	77.4	73.9	70.3	70.9	79.1	82.4	82.9	80.1	84.1	72.2	77.0	77.1
1907, . .	76.1	80.2	73.4	74.1	75.3	76.9	76.4	74.9	83.0	77.7	85.9	80.4	77.9
1908, . .	73.8	84.8	77.9	64.3	74.8	66.2	76.6	79.0	79.1	79.0	79.6	75.1	75.8
1909, . .	78.5	78.9	81.3	76.3	71.2	73.6	71.8	78.1	83.1	76.1	77.2	75.2	76.8
1910, . .	80.9	81.3	72.8	69.1	71.6	75.4	70.3	76.3	82.7	75.0	78.7	78.4	76.0
1911, . .	78.8	77.6	73.2	65.2	72.2	74.5	70.7	77.5	82.4	79.0	73.5	77.3	75.2
1912, . .	81.3	78.4	80.3	77.2	78.5	70.0	71.5	78.3	84.0	74.9	77.2	75.4	77.3
1913, . .	79.0	74.5	79.3	74.4	73.0	68.4	70.5	74.2	80.2	79.2	74.0	81.2	75.7
Mean, .	76.9	77.9	74.6	67.8	68.9	72.4	73.3	76.8	78.6	75.0	75.7	76.5	74.6

Mean Per Cent. of Cloudiness from Tri-daily or Semi-daily Observations.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, . .	55	40	63	55	42	53	54	43	65	60	68	61	55
1890, . .	52	66	66	50	59	50	56	57	59	64	47	53	57
1891, . .	61	59	55	49	54	47	54	58	50	54	50	51	53
1892, . .	63	55	45	42	66	50	35	53	29	46	58	45	49
1893, . .	52	57	46	55	55	58	44	45	46	40	49	54	50
1894, . .	53	53	55	53	52	54	50	44	53	44	50	44	50
1895, . .	51	39	55	54	46	48	58	44	42	42	61	45	49
1896, . .	43	63	54	39	40	47	50	40	52	63	59	42	49
1897, . .	46	51	56	46	47	47	64	42	39	39	71	68	51
1898, . .	66	64	53	68	65	57	53	60	48	62	60	66	60
1899, . .	53	58	66	42	54	54	50	57	47	60	53	52	54
1900, . .	52	62	47	46	54	49	48	49	54	64	72	62	55
1901, . .	58	45	68	75	70	48	63	67	51	48	65	65	60
1902, . .	60	63	66	68	58	62	66	50	57	51	62	60	60
1903, . .	61	53	63	50	36	71	52	63	42	58	41	49	53
1904, . .	55	42	57	52	45	59	55	47	54	42	43	57	51
1905, . .	58	31	46	43	56	61	55	56	48	36	42	56	49
1906, . .	51	44	49	49	47	54	53	50	32	52	53	66	50
1907, . .	58	41	44	33	68	50	42	36	64	30	48	51	49
1908, . .	37	42	48	42	50	28	47	45	27	37	46	49	41
1909, . .	61	60	49	52	56	44	33	35	55	49	56	45	50
1910, . .	60	57	49	56	66	59	34	47	55	44	68	55	54
1911, . .	62	55	49	42	55	54	42	61	53	59	60	63	55
1912, . .	55	36	53	64	64	43	46	50	60	40	51	58	52
1913, . .	63	42	62	55	53	35	39	41	47	63	53	45	50
Mean, .	55.4	51.1	54.6	51.2	54.3	51.3	49.7	49.6	49.2	49.9	55.4	54.5	52.2

Hours of Bright Sunshine by Sun Thermometer.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Possible hours,	294	296	371	402	453	457	462	429	373	341	293	283	4,454
1889, . .	134	183	138	191	270	277	182	194	120	129	84	108	2,010
1890, . .	112	131	160	245	225	264	289	199	166	129	143	131	2,194
1891, . .	126	124	195	240	226	248	222	204	224	150	141	143	2,245
1892, . .	128	138	196	244	183	218	287	201	234	178	101	144	2,261
1893, . .	130	111	172	166	188	209	259	225	185	182	133	112	2,072
1894, . .	120	121	150	174	208	180	237	237	176	160	128	159	2,051
1895, . .	153	187	172	188	243	246	192	251	254	197	111	169	2,363
1896, . .	157	168	210	258	297	263	260	254	189	115	105	172	2,448
1897, . .	144	154	188	239	236	248	214	274	221	209	90	108	2,325
1898, . .	132	138	200	168	200	270	236	201	218	157	126	113	2,159
1899, . .	151	147	134	280	221	235	259	206	200	140	130	142	2,245
1900, . .	167	120	216	227	235	259	260	226	177	136	86	108	2,216
1901, . .	117	172	93	103	159	254	208	160	215	178	100	107	1,866
1902, . .	120	138	143	139	210	179	185	209	149	164	109	119	1,864
1903, . .	114	145	138	199	311	102	247	169	236	154	182	129	2,126
1904, . .	144	173	172	182	256	256	274	292	204	183	148	115	2,401
1905, . .	119	178	216	247	286	217	263	242	186	209	156	128	2,477
1906, . .	128	183	225	269	288	316	278	266	254	189	155	111	2,660
1907, . .	130	200	245	268	209	217	297	217	110	177	125	122	2,317
1908, . .	154	200	220	277	282	362	308	268	242	186	111	133	2,743
1909, . .	127	157	232	220	263	300	290	241	192	194	146	148	2,510
1910, . .	119	180	275	286	287	279	371	229	245	229	137	156	2,793
1911, . .	145	132	236	296	320	280	297	227	195	124	74	105	2,431
1912, . .	149	180	224	198	214	314	260	238	156	163	146	148	2,390
1913, . .	179	205	182	211	221	312	324	282	182	91	113	121	2,423
Mean, .	137	159	189	221	224	253	260	228	197	165	122	130	2,304
Mean per cent., .	46.6	53.4	50.9	55.0	49 5	55.4	56.3	53.3	52.9	48.4	41.6	45.9	51.7

Precipitation (in Inches).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, . .	3.29	1.45	1.46	2.42	4.71	5.01	10.52	2.72	3.17	4.58	6.04	3.57	48.94
1890, . .	2.61	4.20	5.37	1.73	5.39	1.53	5.63	4.88	5.85	7.13	1.32	2.86	48.50
1891, . .	6.75	4.23	2.99	2.66	1.97	4.75	5.28	4.18	2.66	2.94	2.99	5.40	46.80
1892, . .	5.85	1.90	2.40	0.76	6.28	3.46	4.41	6.47	2.16	0.66	4.98	1.01	40.34
1893, . .	3.33	5.75	3.66	4.41	5.02	3.32	2.59	3.49	2.82	4.88	2.81	4.86	46.94
1894, . .	2.16	1.74	1.77	1.83	4.00	3.13	1.55	0.31	4.63	4.85	3.14	3.53	32.64
1895, . .	3.87	1.05	2.71	5.56	2.07	2.76	3.87	3.46	5.04	4.77	5.36	3.94	44.46
1896, . .	1.07	4.67	6.11	1.32	2.58	2.57	4.96	3.84	5.41	3.23	3.03	0.87	39.66
1897, . .	3.00	2.52	3.53	2.42	4.38	6.65	14.51	4.29	1.94	0.73	5.85	7.23	57.05
1898, . .	7.15	3.80	1.63	3.73	5.61	3.69	4.09	6.85	3.65	6.27	5.48	2.30	54.25
1899, . .	2.80	3.56	7.13	1.79	1.28	4.13	4.89	2.00	7.90	1.84	2.17	2.00	41.49
1900, . .	4.08	8.12	5.76	1.85	3.78	3.65	4.67	4.11	3.67	3.72	5.87	2.40	51.68
1901, . .	1.81	0.62	5.66	5.95	6.91	0.87	3.86	6.14	4.17	3.88	2.08	7.77	49.72
1902, . .	1.72	3.54	5.29	3.31	2.32	4.54	4.66	4.65	5.83	5.59	1.27	4.27	46.99
1903, . .	3.28	4.27	6.40	2.30	0.48	7.79	4.64	4.92	1.66	2.72	2.04	3.95	44.45
1904, . .	4.74	2.45	4.48	5.73	4.55	5.35	2.62	4.09	5.45	1.74	1.35	2.75	45.30
1905, . .	3.90	1.70	3.66	2.56	1.28	2.86	2.63	6.47	6.26	2.27	2.06	3.15	38.80
1906, . .	2.18	2.73	4.90	3.25	4.95	2.82	3.45	6.42	2.59	5.69	1.98	4.49	45.45
1907, . .	2.73	1.92	1.82	1.98	4.02	2.36	3.87	1.44	8.74	5.00	4.50	3.89	42.27
1908, . .	2.25	3.53	2.86	1.97	4.35	0.76	3.28	4.27	1.73	1.57	1.06	3.05	30.68
1909, . .	3.56	5.16	3.01	5.53	3.36	2.24	2.24	3.79	4.99	1.23	1.06	2.95	39.12
1910, . .	6.14	5.08	1.37	3.07	2.67	2.65	1.90	4.03	2.86	0.93	3.69	1.72	36.11
1911, . .	2.36	2.18	3.80	1.87	1.37	2.02	4.21	5.92	3.41	8.81	3.84	4.42	44.21
1912, . .	2.18	3.16	5.70	3.92	4.34	0.77	2.61	3.22	2.52	2.07	4.03	4.04	38.56
1913, . .	3.98	2.94	6.38	3.30	4.94	0.90	1.59	2.26	2.56	5.16	2.11	3.38	39.50
Mean, .	3.47	3.28	3.99	3.01	3.74	3.22	4.34	4.17	4.07	3.69	3.20	3.59	43.76

Wind Movement (in Miles).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, .	5,101	4,828	7,068	5,648	4,056	4,056	4,032	2,811	4,310	4,762	2,589	4,445	53,706
1890, .	4,914	4,616	5,395	5,032	5,284	3,776	3,976	4,116	3,507	4,143	4,228	5,673	54,648
1891, .	4,954	4,759	6,261	5,484	4,610	3,713	3,907	3,324	3,201	4,319	5,215	5,465	55,212
1892, .	5,059	3,438	7,046	5,370	5,056	4,500	3,365	3,390	3,672	4,071	5,231	4,522	54,720
1893, .	4,056	5,242	5,757	5,384	4,833	3,572	3,640	4,126	3,508	4,198	4,179	3,916	52,411
1894, .	4,193	4,865	4,406	4,105	2,180	1,838	1,109	1,920	1,414	2,540	4,179	3,508	36,257
1895, .	2,896	3,920	4,360	4,098	4,071	3,050	2,934	3,397	3,444	4,029	4,156	5,506	46,861
1896, .	4,943	6,445	8,182	4,674	4,838	3,926	4,048	2,968	4,686	4,544	4,654	5,290	59,198
1897, .	5,501	4,493	5,363	5,523	5,603	4,208	4,007	3,452	3,506	3,938	4,558	4,068	54,220
1898, .	3,494	3,699	3,864	5,477	4,769	4,162	3,377	3,111	2,787	3,999	4,856	4,830	48,425
1899, .	4,926	4,427	5,275	3,984	4,219	3,814	3,891	2,522	3,967	2,582	3,361	4,142	47,110
1900, .	4,904	5,016	5,602	5,039	4,381	4,101	3,701	2,322	3,042	3,315	4,877	4,203	50,503
1901, .	5,224	5,484	5,482	6,211	4,525	3,647	2,763	2,144	2,358	3,652	4,583	4,280	50,353
1902, .	4,078	5,199	6,601	4,642	4,328	4,102	2,929	2,386	2,680	4,398	3,077	4,018	48,438
1903, .	4,254	4,529	4,169	5,125	3,908	3,130	3,087	2,105	2,890	4,703	3,362	4,994	46,256
1904, .	4,112	4,910	4,444	4,902	3,830	3,127	3,268	3,232	3,602	4,160	3,470	3,940	46,994
1905, .	5,180	4,503	3,006	4,855	5,004	3,108	3,464	3,030	2,527	3,397	4,317	4,051	46,442
1906, .	5,706	4,565	5,686	4,777	3,766	1,409	3,773	3,412	4,249	4,398	5,978	5,554	53,273
1907, .	4,987	5,272	5,718	7,096	5,946	4,223	4,114	3,928	3,582	5,111	4,773	5,266	60,016
1908, .	7,770	5,511	5,759	8,208	5,818	4,571	3,815	3,802	3,757	3,643	5,485	5,432	63,571
1909, .	5,991	5,585	7,034	6,679	5,371	4,225	5,097	3,485	4,008	4,400	5,793	5,845	63,513
1910, .	5,786	5,834	5,579	5,533	5,289	3,685	3,812	4,271	3,336	5,467	5,215	5,435	59,242
1911, .	6,085	5,515	7,485	5,738	4,939	3,546	3,878	3,029	3,809	3,451	5,950	4,857	58,282
1912, .	4,872	4,798	5,291	6,094	5,332	4,533	3,992	3,698	2,980	3,953	5,037	5,337	55,897
1913, .	5,359	5,194	6,413	5,659	3,672	3,746	4,315	3,441	3,220	4,698	5,003	4,400	55,120
Mean, .	4,974	4,906	5,650	5,413	4,625	3,671	3,612	3,177	3,362	4,115	4,565	4,759	52,827

Maximum Wind Pressure (in Pounds per Square Foot).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Maximum Annual.
1889, . .	26.0	24.0	16.7	15.5	9.0	11.5	10.0	6.5	9.7	12.2	14.5	29.0	29.0
1890, . .	27.7	17.5	13.5	11.5	16.5	10.0	9.2	13.0	5.0	11.0	9.5	24.5	27.7
1891, . .	16.2	13.5	10.5	14.0	10.7	10.5	4.5	2.5	4.0	9.5	15.7	14.0	16.2
1892, . .	10.5	11.5	20.5	16.7	15.7	20.5	11.5	7.5	15.5	12.5	16.0	13.5	20.5
1893, . .	12.0	20.0	18.5	24.5	24.7	9.0	13.0	37.5	14.5	23.0	14.0	18.5	37.5
1894, . .	20.0	22.5	11.5	15.5	14.5	14.0	9.5	9.5	13.0	10.0	18.0	15.0	22.5
1895, . .	13.0	25.0	20.0	10.0	7.0	8.0	8.0	5.5	43.0	14.0	22.0	24.0	43.0
1896, . .	15.0	24.5	19.0	18.0	25.0	7.7	8.5	12.5	19.0	12.0	15.0	12.0	25.0
1897, . .	18.5	10.0	13.5	14.0	22.0	7.0	12.0	14.0	20.0	11.5	20.0	12.0	22.0
1898, . .	22.5	15.5	15.5	10.0	18.0	8.5	17.5	13.0	30.5	12.0	19.0	28.0	30.5
1899, . .	20.0	15.0	22.0	9.5	10.5	7.5	12.0	5.5	6.5	6.5	11.0	15.5	22.0
1900, . .	20.5	30.5	16.0	13.0	22.0	12.5	23.0	16.0	17.0	10.0	18.0	13.0	30.5
1901, . .	12.5	10.5	10.5	13.5	11.5	7.5	14.5	2.0	24.0	9.0	17.5	14.5	24.0
1902, . .	12.0	24.0	24.0	14.0	10.0	15.0	7.5	8.0	4.0	8.0	9.5	12.5	24.0
1903, . .	12.5	22.0	8.0	12.5	9.5	9.0	15.5	3.0	7.5	3.0	9.5	17.0	22.0
1904, . .	11.0	23.5	14.5	15.5	11.0	6.0	11.0	6.5	14.5	23.5	11.5	9.5	23.5
1905, . .	23.5	18.0	16.5	18.0	9.5	6.0	9.0	7.0	7.0	9.0	9.0	14.0	23.5
1906, . .	8.0	8.5	7.0	10.0	7.5	5.0	6.5	4.5	4.5	9.0	8.5	12.0	12.0
1907, . .	14.0	20.0	27.0	12.0	6.5	6.0	32.5	4.5	6.0	9.0	8.5	18.5	32.5
1908, . .	16.0	23.0	10.0	32.0	13.0	7.0	10.0	4.0	9.0	9.0	9.5	7.5	32.0
1909, . .	8.5	18.5	18.0	27.5	8.0	7.0	7.0	3.0	5.5	8.5	13.0	14.0	27.5
1910, . .	15.0	15.0	11.5	6.0	7.5	4.0	6.0	8.5	2.5	8.0	7.5	10.5	15.0
1911, . .	19.0	9.5	21.0	9.0	7.5	5.0	7.5	3.0	5.0	6.0	15.0	30.5	30.5
1912, . .	19.5	23.0	6.0	10.0	13.5	8.5	5.5	6.5	3.5	5.0	18.0	10.0	23.0
1913, . .	18.0	13.5	23.5	16.5	5.5	4.5	27.0	4.5	6.5	23.0	14.5	7.0	27.0
Maximum,	27.7	30.5	27.0	32.0	25.0	20.5	32.5	37.5	43.0	23.5	22.0	30.5	43.0

Maximum Velocity of Wind (in Miles per Hour).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Maximum Annual.
1889, . .	72	69	58	56	42	48	45	36	44	50	54	76	76
1890, . .	74	59	52	48	57	45	43	51	32	47	44	70	74
1891, . .	57	52	46	53	46	46	30	23	28	44	56	53	57
1892, . .	46	48	64	58	56	64	48	39	56	50	57	52	64
1893, . .	49	63	61	70	70	42	51	87	54	68	53	61	87
1894, . .	63	67	48	56	54	53	44	44	51	45	60	55	67
1895, . .	51	71	63	45	37	40	40	33	93	53	66	69	93
1896, . .	55	70	62	60	71	39	41	50	62	49	55	49	71
1897, . .	61	45	52	53	66	37	49	53	63	48	63	49	66
1898, . .	67	56	56	45	60	41	59	51	78	49	62	75	78
1899, . .	64	55	66	44	46	39	49	33	36	36	47	56	66
1900, . .	64	78	57	51	66	50	68	57	60	45	60	51	78
1901, . .	49	46	46	52	48	39	54	20	69	42	59	54	69
1902, . .	49	69	69	53	45	55	39	40	28	40	44	50	69
1903, . .	50	66	40	50	44	43	56	24	39	40	44	58	66
1904, . .	47	69	54	56	47	35	47	36	54	69	48	44	69
1905, . .	69	60	57	60	44	35	43	37	37	43	43	53	69
1906, . .	45	41	37	45	39	32	36	30	30	42	41	49	49
1907, . .	53	63	74	49	36	35	81	30	35	42	41	61	81
1908, . .	56	68	45	80	51	37	45	28	42	42	44	39	80
1909, . .	41	61	60	74	40	37	37	24	33	41	51	53	74
1910, . .	55	55	48	35	39	28	35	41	22	40	39	46	55
1911, . .	62	44	65	42	39	32	39	24	32	35	55	79	79
1912, . .	62	68	35	45	52	41	33	36	26	32	60	45	68
1913, . .	60	52	68	58	33	30	73	30	36	68	54	37	73

Snow, Frost and Weather.

Year.	Last Snow.	First Snow.	Total Snowfall (Inches).	Last Frost.	First Frost.	Number of Days of Precipitation.	Number of Clear Days.	Number of Fair Days.	Number of Cloudy Days.
1889, . .	April 2	Oct. 13	26.0	May 26	Sept. 21	119	94	110	161
1890, . .	April 8	Oct. 19	43.5	May 12	Sept. 25	141	137	105	123
1891, . .	May 5	Nov. 26	54.2	May 19	Oct. 12	112	145	103	117
1892, . .	April 10	Nov. 5	42.5	May 10	Sept. 30	108	123	109	134
1893, . .	April 21	Nov. 4	74.3	May 8	Sept. 3	143	101	96	168
1894, . .	April 12	Nov. 5	71.5	May 22	Aug. 22	125	107	83	175
1895, . .	April 3	Oct. 20	61.0	May 17	Aug. 22	119	118	110	137
1896, . .	April 7	Nov. 14	44.0	May 1	Sept. 24	108	132	192	132
1897, . .	April 27	Nov. 12	52.8	May 8	Sept. 22	127	108	109	148
1898, . .	April 6	Nov. 24	69.5	April 27	Sept. 21	125	78	138	149
1899, . .	April 16	Oct. 12	52.0	May 4	Sept. 14	110	91	139	135
1900, . .	April 9	Nov. 9	37.0	May 29	Sept. 15	131	83	144	138
1901, . .	April 3	Nov. 11	52.3	May 6	Sept. 26	135	81	105	179
1902, . .	April 2	Oct. 29	57.0	May 14	Sept. 6	144	73	113	179
1903, . .	April 4	Oct. 26	33.5	May 2	Sept. 25	116	119	98	148
1904, . .	April 20	Oct. 12	59.5	April 23	Sept. 22	126	142	96	128
1905, . .	May 1	Nov. 9	40.0	May 24	Sept. 12	122	130	128	107
1906, . .	April 23	Nov. 11	56.2	May 20	Sept. 25	121	130	140	95
1907, . .	May 11	Nov. 23	54.5	May 22	Sept. 27	122	95	155	115
1908, . .	April 20	Nov. 5	38.5	June 3	Sept. 16	109	143	130	93
1909, . .	April 9	Nov. 5	31.0	May 12	Oct. 13	128	112	151	102
1910, . .	Mar. 14	Nov. 8	44.5	May 6	Sept. 23	117	142	152	71
1911, . .	April 19	Nov. 14	35.0	May 5	Sept. 14	120	106	131	128
1912, . .	April 9	Nov. 3	33.8	May 1	Aug. 31	117	71	182	113
1913, . .	April 9	Oct. 31	26.5	May 15	Sept. 10	135	105	144	116

Summary for the Twenty-five Years 1889-1913, inclusive.

Barometer (Pressure in Inches).

Maximum reduced to freezing, Feb. 26, 1889, 11 A.M.,	30.650
Minimum reduced to freezing, Feb. 8, 1895, 7 A.M.,	28.240
Maximum reduced to freezing and sea level, Feb. 26, 1889, 11 A.M.,	30.970
Minimum reduced to freezing and sea level, Jan. 3, 1913, 7 A.M.,	28.550
Mean,	30.012
Total range,	2.420
Greatest annual range, 1913,	2.330
Least annual range, 1905,	1.640
Mean annual range,	1.890
Greatest monthly range, January, 1913,	2.180
Least monthly range, August, 1894,	.440
Mean monthly range,	1.100

Air Temperature (in Degrees F.).

Highest, July 4, 1911, 3.30 P.M.,	104.0
Lowest, Jan. 5, 1904, 7.30 A.M.,	−26.0
Mean,	47.5
Total range,	130.0
Greatest annual range, 1904,	120.5
Least annual range, 1906,	98.5
Mean annual range,	107.6
Greatest monthly range, January, 1907,	78.0
Least monthly range, August, 1901,	33.5
Mean monthly range,	54.6
Greatest daily range, Dec. 10, 1902,	54.0
Least daily range, June 2, 1907,	2.0

Humidity.

Mean dew point,	39.0
Mean relative humidity,	74.6

Precipitation (in Inches).

Total rain or melted snow,	1,093.91
Total snowfall,	1,190.70
Greatest annual precipitation, 1897,	57.05
Least annual precipitation, 1908,	30.68
Mean annual precipitation,	43.76
Greatest monthly precipitation, July, 1897,	14.51
Least monthly precipitation, August, 1894,	.31
Mean monthly precipitation,	3.65

Wind (in Miles).

Total movement,	1,320,668
Greatest annual movement, 1908,	63,571
Least annual movement, 1894,	36,257
Mean annual movement,	52,827
Greatest monthly movement, April, 1908,	8,208
Least monthly movement, July, 1894,	1,109
Mean monthly movement,	4,402
Greatest daily movement, April 8, 1909,	705
Least daily movement, Sept. 29, 1894, March 7, 1890, Jan. 6, 1904,	0
Mean daily movement,	145

Maximum pressure per square foot, 43 pounds, = 93 miles per hour, Sept. 11, 1895, 3 P.M.

Weather.

Mean cloudiness observed, per cent.,	52.2
Total cloudiness by the sun thermometer, per cent.,	48.3
Number of clear days,	2,766
Number of fair days,	3,073
Number of cloudy days,	3,291

Gales of 75 or more miles per hour: 1889, Dec. 26, 76, N.W.; 1893, Aug. 29, 87, S.W.; 1895, Sept. 11, 93, N.E.; 1898, Sept. 7, 78, S.W.; Dec. 4, 75, E.S.E.; 1900, Feb. 22, 78, W.N.W.; 1907, July 20, 81, W.; 1908, April 11, 80, N.N.W.; 1911, Dec. 28, 79, W.N.W.

The following summary was abstracted from meteorological records taken in Amherst prior to the establishment of the meteorological observatory at the college in 1889.

The records from 1836 to 1883 are from the observations of the late Prof. E. S. Snell of Amherst College. These records were taken at his house, about one and a half miles south of the location of the meteorological observatory at the Massachusetts Agricultural College, and at practically the same elevation above sea level.

The precipitation records are believed to be fairly comparable with the records of this station, although perhaps slightly affected by the difference of topography surrounding the two places. As Professor Snell changed his time of taking temperatures, and used different methods of deducing the mean temperatures in conformity with the current practices at dif-

ferent dates, the comparison with those of this station should be made with more caution. The maximum and minimum temperatures of the earlier years were not all taken with self-registering instruments, and this fact should be taken into consideration when comparisons are made.

The records from 1883 to 1889 were taken at the State Experiment Station, on the college grounds, under the direction of Dr. C. A. Goessmann, at that time the director of the State Agricultural Experiment Station, and are fairly comparable with the records of this station.

Mean temperature for seventy-seven years: —

$$\frac{47.5 \times 25 + 46.7 \times 52}{77} = 46.9 \text{ degrees.}$$

Mean precipitation for seventy-eight years: —

$$\frac{44.36 \times 53 + 43.76 \times 25}{78} = 44.17 \text{ inches.}$$

Record of the Rainfall in Inches from 1836 to 1888, inclusive.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1836, . .	4.21	3.83	3.13	1.98	2.59	3.45	6.02	0.96	2.28	3.02	3.49	5.80	40.76
1837, . .	1.75	2.42	2.65	4.33	5.76	4.49	7.35	2.57	1.07	2.06	1.90	2.35	38.70
1838, . .	2.45	1.67	1.69	2.02	3.63	4.90	2.27	3.95	6.38	4.12	5.77	0.96	39.81
1839, . .	1.66	1.75	1.69	4.14	3.49	3.30	9.56	2.51	2.82	1.78	3.04	7.09	42.83
1840, . .	3.15	2.03	3.18	3.98	1.91	4 60	3.34	6.82	5.20	5.04	4.61	3.15	47.01
1841, . .	5.80	1.50	2.85	4.52	3.47	1.65	2.55	3.18	3.50	3.73	2.80	6.08	41.63
1842, . .	1.02	3.78	2.39	2.92	2.40	3.18	1.95	7.42	3.23	2.84	3.73	3.19	38.05
1843, . .	1.99	3.49	5.73	4.82	2.09	5.18	2.53	9.38	1.57	9.45	3.07	2.28	51.58
1844, . .	3.44	2.18	4.12	0.57	5.59	3.00	3.81	4.93	1.84	6.49	2.12	2.49	40.58
1845, . .	4.97	3.37	3.56	1.70	2.42	2.57	3.31	2.79	2.58	4.66	3.90	3.91	39.74
1846, . .	2 74	2.55	4.35	1.54	4.33	3.10	3.25	2.44	0.47	2.09	4.96	3.10	34.92
1847, . .	4 86	4.88	3.57	1.41	1.91	4.44	4.48	4.06	3.63	3.99	4.17	6.41	47.81
1848, . .	2.92	2.60	3.03	1.55	6.18	2.58	4.72	1.53	2.49	3.15	3.09	5.54	39.38
1849, . .	0.99	0.99	4.21	2.24	3.61	1.53	2.25	7.86	1.40	6.36	3.65	3.36	38.45
1850, . .	4.75	3.56	1.86	3.93	8.72	2.88	6.81	6.50	4.93	3.65	2.63	5.37	55.59
1851, . .	1.66	5.07	1.28	4.43	4.07	3.69	4.31	3.03	2.05	5.43	5.30	3.17	43.50
1852, . .	2.42	3.35	3.26	4.71	2.30	2.54	3.38	5.19	2.48	1.76	6.43	4.88	42.70
1853, . .	2.11	6.69	2.39	3.79	5.40	2.64	3.59	7.13	5.66	3.75	6.24	1.84	51.23
1854, . .	2.01	4.53	3.11	8.33	3.19	1.75	3.53	0.99	5.46	2.31	7.48	2.39	45.08
1855, . .	5.06	2.70	1.08	3.85	1.49	5.19	6.10	2.55	0.55	10.08	4.12	5.41	48.18
1856, . .	2.48	0.79	1.12	2.51	5.31	1.92	1.96	12.13	3.47	1.40	2.85	4.19	40.13
1857, . .	3.55	2.41	2.12	7.68	6.82	2.66	4.98	3.14	3.04	3.88	2.07	5.31	47.66
1858, . .	3.52	1.60	0.80	3.20	2.98	4.62	6.73	4.82	4.14	3.86	2.16	3.16	41.59
1859, . .	4.89	3.54	6.27	2.96	4.08	6.16	2.61	6.65	4.47	1.85	2.96	4.85	51.29
1860, . .	1.21	2.93	1.58	1.28	4.57	3.57	6.13	2.68	6.12	2.18	3.52	3.84	39.61
1861, . .	4.34	3.28	3.76	5.65	4.45	2.69	5.23	4.10	2.75	4.53	3.93	2.17	46.88
1862, . .	5.25	2.84	4.20	2.28	2.33	11.69	5.12	2.98	2.12	3.28	4.76	1.91	48.86
1863, . .	5.05	4.43	5.60	2.33	3.59	4.09	8.64	6.11	2.16	4.04	5.28	4.87	56.19
1864, . .	2.20	1.12	2.58	2.57	2.54	1.38	0.96	4.40	2.92	2.94	6.20	4.63	34.44
1865, . .	3.48	2.88	5.98	2.90	7.89	2.94	3.72	1.86	0.37	4.98	2.45	3.54	42.99
1866, . .	1.36	4.62	3.16	2.03	4.48	5.66	4.02	3.96	4.71	3.38	3.86	3.57	44.81
1867, . .	1.32	3.65	3.12	3.79	4.61	5.67	4.00	9.16	1.11	3.85	4.31	1.51	46.10
1868, . .	3.52	1.03	3.25	4.27	7.66	2.44	3.28	5.67	10.63	1.37	4.80	1.47	49.59
1869, . .	3.47	4.14	5.46	1.53	5.65	5.99	2.98	1.04	4.32	11.36	2.59	4.96	53.49
1870, . .	5.87	5.25	2.71	3.70	1.72	2.73	2.53	2.83	1.75	4.49	3.28	1.84	38.70
1871, . .	1.96	2.91	3.99	3.09	3.82	6.58	3.52	6.45	1.30	6.09	3.51	2.67	45.89
1872, . .	1.51	1.89	2.87	2.20	3.11	3.25	7.07	5.28	6.20	3.64	4.48	2.69	44.19
1873, . .	5.01	2.17	3.13	1.74	3.91	1.59	2.93	3.47	4.77	6.36	3.51	3.31	41.90
1874, . .	5.46	2.19	1.35	6.03	5.22	5.06	11.58	2.69	1.82	1.85	3.54	1.17	47.96
1875, . .	2.90	3.62	4.20	3.33	2.19	2.89	8.15	6.17	4.65	3.89	3.97	1.03	46.99
1876, . .	2.31	5.53	7.14	3.11	3.96	3.87	4.84	0.27	3.71	1.12	2.49	3.22	41.57
1877, . .	2.52	0.36	6.97	2.45	1.93	4.59	6.47	2.79	0.91	6.99	5.44	1.02	42.44
1878, . .	3.58	3.67	2.57	5.85	2.36	6.00	2.16	6.97	2.82	2.05	5.34	6.02	49.39
1879, . .	1.75	3.49	2.98	3.85	3.32	5.37	5.75	5.89	2.59	1.80	2.35	4.85	45.99
1880, . .	4.58	3.60	2.68	2.64	1.90	1.40	6.34	2.91	2.69	2.27	2.50	2.29	35.80
1881, . .	4.01	1.77	4.86	1.65	4.28	3.95	1.50	2.76	2.37	4.24	4.58	6.15	42.12
1882, . .	5.44	4.23	5.20	1.52	6.50	2.25	1.83	0.25	11.85	1.67	1.33	1.47	43.54
1883, . .	3.24	4.03	1.70	2.18	6.20	3.99	3.69	1.57	3.17	4.31	1.80	2.99	38.87
1884, . .	3.60	4.62	5.67	2.48	2.02	1.38	3.75	5.10	1.25	2.40	2.53	5.58	40.38
1885, . .	3.78	3.88	0.86	3.38	3.08	3.49	2.07	8.31	0.85	3.65	5.54	3.54	42.43
1886, . .	5.39	3.94	3.31	1.73	3.10	2.33	3.82	2.60	5.48	2.97	5.25	3.61	43.53
1887, . .	4.57	5 05	4.05	2.98	1.13	5.09	8.93	7.75	1.22	2.10	3.35	4.11	50.33
1888, . .	3.87	3.94	5.96	3.08	4.29	5.40	3.63	4.29	10.70	5.19	3.91	3.78	58.04
Mean, .	3.34	3.18	3.44	3.18	3.88	3.76	4.45	4.39	3.43	3.88	3.83	3.59	44.36

Record of the Mean Temperature from 1837 to 1888, inclusive.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1837, . .	20.3	26.7	33.7	47.4	57.9	68.2	70.6	68.6	61.4	50.0	40.2	27.6	47.7
1838, . .	32.0	19.6	36.4	40.7	54.3	68.6	71.9	68.2	62.7	46.5	34.1	23.5	46.5
1839, . .	24.6	29.8	37.5	52.2	60.7	65.4	74.4	70.7	63.5	53.3	36.6	28.9	49.8
1840, . .	14.4	28.5	35.0	49.0	57.1	65.5	70.6	70.3	57.2	47.4	37.0	23.6	46.3
1841, . .	25.6	20.2	31.9	41.6	54.4	68.4	69.5	69.8	61.2	42.8	35.3	29.5	45.8
1842, . .	25.6	30.5	37.7	46.5	52.7	64.1	71.5	69.0	57.4	47.4	35.1	24.2	46.8
1843, . .	29.7	16.5	24.5	44.6	56.0	65.3	68.8	69.8	61.7	45.0	34.0	28.0	45.3
1844, . .	13.9	22.1	35.5	52.0	57.8	65.6	68.2	68.0	59.6	47.6	35.7	27.3	46.0
1845, . .	24.5	24.9	36.9	45.6	56.2	66.7	72.1	71.5	58.3	49.6	41.5	21.5	47.4
1846, . .	24.8	20.1	36.3	50.1	58.3	65.0	70.7	69.6	65.5	47.6	43.0	25.3	48.0
1847, . .	25.5	24.7	29.2	43.3	57.5	64.7	72.4	69.3	59.3	46.0	43.2	34.2	47.4
1848, . .	29.0	23.7	32.6	43.3	59.5	67.6	69.4	70.6	57.4	47.3	33.5	30.6	47.0
1849, . .	20.0	18.5	35.6	43.5	53.4	66.9	72.1	68.8	60.0	47.0	44.1	28.4	46.5
1850, . .	25.9	28.4	32.4	42.9	53.4	67.3	72.1	67.1	59.4	48.2	40.0	23.4	46.7
1851, . .	23.8	27.9	35.5	46.2	55.6	69.6	69.2	66.2	60.9	51.0	34.5	20.2	46.2
1852, . .	19.6	25.2	30.9	39.4	56.0	65.4	70.0	65.2	58.4	49.3	36.4	32.8	45.7
1853, . .	24.3	26.7	33.8	44.0	56.7	67.0	68.7	67.8	59.5	46.8	39.1	26.3	46.7
1854, . .	22.8	22.0	31.6	43.5	59.5	66.7	74.1	68.8	61.5	51.5	40.3	22.3	47.0
1855, . .	27.3	19.8	31.5	43.8	56.6	65.0	70.9	65.5	60.8	49.7	38.8	28.2	46.5
1856, . .	15.2	19.0	25.9	46.4	53.6	68.6	72.9	66.2	60.8	48.7	37.5	23.2	44.8
1857, . .	13.5	31.4	31.1	41.0	55.2	63.6	70.9	67.2	59.9	48.9	39.5	31.5	46.1
1858, . .	28.8	20.6	31.3	44.4	54.1	66.1	69.8	67.9	50.9	51.4	33.9	25.7	45.4
1859, . .	22.9	25.6	36.7	43.4	59.2	62.8	67.7	66.4	57.1	45.7	41.1	23.0	46.0
1860, . .	26.5	24.8	37.2	44.0	57.3	65.2	66.4	68.0	56.8	48.8	42.7	23.9	46.8
1861, . .	20.4	29.2	32.5	45.5	53.4	65.5	69.5	65.7	59.9	51.5	37.8	29.0	46.7
1862, . .	22.3	22.1	32.2	43.6	58.1	63.4	68.0	68.1	61.1	51.0	39.6	27.6	46.4
1863, . .	29.1	26.3	26.1	45.5	55.4	59.0	70.9	70.1	57.4	49.9	41.1	25.3	46.3
1864, . .	24.4	28.5	34.4	43.5	60.4	65.7	71.5	70.8	57.8	46.4	38.0	38.2	48.3
1865, . .	18.7	25.0	37.1	49.0	57.1	69.3	69.1	68.6	65.6	46.0	39.9	28.9	47.8
1866, . .	21.9	26.2	31.6	48.6	54.6	65.8	72.9	63.5	60.0	49.5	40.1	26.3	46.7
1867, . .	18.3	31.2	30.8	45.5	54.0	67.1	68.1	68.6	60.0	49.9	37.9	22.6	46.2
1868, . .	20.2	18.2	33.8	42.0	55.1	66.2	74.0	69.0	59.5	45.3	36.5	22.8	45.2
1869, . .	28.0	28.0	27.3	46.4	55.9	64.7	69.1	66.9	62.1	46.7	35.9	27.5	46.5
1870, . .	30.8	25.3	30.9	48.3	58.3	70.4	73.6	71.1	62.3	52.0	39.1	28.0	49.2
1871, . .	23.3	26.0	40.5	48.0	57.8	65.4	69.2	68.9	52.8	51.0	34.0	24.6	46.8
1872, . .	25.1	24.2	25.3	45.0	59.1	68.1	72.6	71.6	61.7	48.2	36.4	19.5	46.4
1873, . .	20.6	24.0	30.6	43.2	54.6	67.5	71.3	67.0	60.4	49.9	29.7	29.2	45.7
1874, . .	28.2	24.5	32.9	38.3	56.5	66.2	67.2	65.6	62.0	47.6	36.2	29.2	46.2
1875, . .	16.7	17.5	27.8	40.8	57.1	65.8	69.3	68.9	57.3	47.9	33.1	28.3	44.2
1876, . .	29.8	26.4	31.6	43.6	57.5	70.6	74.2	70.5	59.1	45.5	40.5	19.7	47.4
1877, . .	20.0	30.8	33.3	47.8	58.5	67.8	71.1	71.4	63.3	50.5	41.9	33.1	49.1
1878, . .	25,3	27.1	39.2	52.2	57.4	64.7	73.3	68.6	63.2	54.4	39.1	29.0	49.5
1879, . .	21.6	22.4	33.0	43.2	60.6	66.3	71.0	67.2	59.0	56.0	37.4	30.8	47.4
1880, . .	31.6	29.1	33.5	47.5	64.2	68.5	71.8	67.5	63.2	47.3	34.9	22.8	48.5
1881, . .	17.9	24.9	36.2	43.6	61.7	62.8	70.6	70.5	67.4	52.5	40.3	36.0	48.7
1882, . .	23.6	28.2	35.1	44.3	52.9	66.8	71.9	70.9	63.2	52.7	36.4	26.6	47.7
1883, . .	21.0	25.0	27.3	44.3	58.6	69.7	70.4	66.4	59.4	46.8	40.4	27.0	46.4
1884, . .	21.6	30.9	32.9	46.7	57.4	69.0	68.6	69.2	64.4	50.3	38.4	30.0	48.3
1885, . .	22.7	15.2	23.3	45.3	54.8	63.8	70.4	66.0	58.3	49.1	39.8	29.6	44.9
1886, . .	21.8	35.1	33.5	50.4	57.3	63.2	68.8	66.3	59.5	48.9	38.3	23.0	46.2
1887, . .	19.4	24.2	26.4	41.6	60.9	65.7	73.7	64.9	55.9	47.0	36.5	26.6	45.2
1888, . .	13.8	22.0	26.8	40.4	54.7	65.8	67.2	67.4	57.1	43.1	38.9	30.4	44.0
Mean, .	23.0	24.7	32.4	45.1	56.9	66.1	70.7	68.3	60.1	48.7	38.0	27.0	46.7

Record of the Maximum Temperature from 1838 to 1888, inclusive.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1838, . .	55.0	42.0	58.0	67.0	80.0	90.0	92.0	88.0	85.0	77.0	57.0	43.0	92.0
1839, . .	50.0	50.0	65.0	72.0	80.0	84.0	86.0	85.0	80.0	70.0	56.0	53.0	86.0
1840, . .	38.0	56.0	64.0	79.0	88.0	88.0	94.0	90.0	77.0	72.0	55.0	44.0	94.0
1841, . .	50.0	44.0	60.0	67.0	81.0	90.0	94.0	88.0	84.0	64 0	68.0	44.0	94.0
1842, . .	37.0	55.0	68.0	82.0	78.0	84.0	90.0	82.0	84.0	70.0	60.0	43.0	90.0
1843, . .	50.0	37.0	42.0	70.0	82.0	86.0	91.0	84.0	87.0	69.0	57.0	40.0	91.0
1844, . .	39.0	49.0	56.0	83.0	84.0	86.0	86.0	84.0	83.0	70.0	54.0	45.0	86.0
1845, . .	46.0	55.0	71.0	77.0	88.0	90.0	94.0	89.0	81.0	74.0	65.0	38.0	94.0
1846, . .	45.0	40.0	59.0	76.0	83.0	87.0	93.0	90.0	88.0	81.0	61.0	45.0	93.0
1847, . .	44.0	47.0	52.0	77.0	84.0	88.0	91.0	85.0	85.0	67.0	70.0	59.0	91.0
1848, . .	56.0	43.0	64.0	74.0	86.0	90.0	87.0	87.0	81.0	70.0	52.0	58.0	90.0
1849, . .	46.0	43.0	60.0	68.0	83.0	92.0	93.0	83.0	70.0	68.0	63.0	43.0	93.0
1850, . .	45.0	52.0	60.0	70.0	73.0	90.0	87.0	87.0	80.0	67.0	63.0	49.0	90.0
1851, . .	48.0	48.0	73.0	67.0	82.0	88.0	87.0	83.0	80.0	73.0	56.0	44.0	88.0
1852, . .	43.2	47.4	53.0	61.0	79.0	84.0	90.0	85.7	85.0	70.0	50.8	56.0	90.0
1853, . .	45.0	51.0	56.4	76.3	84.2	91.3	85.1	91.7	84.7	69.0	59.5	42.8	91.7
1854, . .	50.4	45.0	65.4	70.6	79.0	87.5	97.0	88.5	90.0	75.8	66.0	41.5	97.0
1855, . .	48.0	42.0	57.8	76.0	81.0	92.0	91.6	84.5	85.0	73.0	63.0	46.2	92.0
1856, . .	34.8	38.6	44.9	76.7	89.0	94.0	95.0	87.3	78.9	75.5	61.0	41.8	95.0
1857, . .	37.1	61.8	54.5	58.3	86.4	86.9	90.3	90.3	85.7	73.0	67.0	52.0	90.3
1858, . .	51.4	47.1	57.7	68.1	74.2	90.3	92.0	79.0	85.2	73.0	59.0	42.8	92.0
1859, . .	39.4	44.1	56.6	71.0	86.0	91.5	90.0	81.8	73.8	75.0	65.8	62.9	91.5
1860, . .	50.3	52.0	71.3	68.3	81.0	83.0	84.0	84.4	79.0	69.9	66.7	37.5	84.4
1861, . .	38.0	53.5	56.3	80.3	77.2	84.0	91.7	90.0	82.3	75.5	64.0	51.4	91.7
1862, . .	42.9	40.0	44.5	72.9	84.0	86.0	90.0	88.0	80.0	83.0	68.2	52.0	90.0
1863, . .	52.0	45.3	47.3	77.0	88.0	85.6	85.5	90.0	80.0	71.0	65.4	51.5	90.0
1864, . .	44.2	46.8	53.8	64.8	86.0	93.5	91.9	98.0	80.0	68.7	62.0	49.4	98.0
1865, . .	39.5	45.4	63.7	79.5	85.8	87.0	85.4	90.0	89.0	72.0	68.0	54.9	90.0
1866, . .	40.0	55.0	55.8	84.2	80.0	90.1	94.0	81.6	83.1	73.0	60.8	51.2	94.0
1867, . .	33.5	50.0	53.0	66.0	75.5	85.0	90.0	83.5	80.0	76.0	65.0	46.0	90.0
1868, . .	39.5	45.0	59.8	67.5	75.0	88.7	94.5	85.0	79.5	68.0	58.0	42.7	94.5
1869, . .	49.0	50.6	53.8	74.0	83.0	80.7	89.9	87.2	85.0	71.4	56.9	45.3	89.9
1870, . .	54.3	55.0	50.5	78.0	82.4	93.0	91.2	91.3	83.5	71.5	61.0	47.0	93.0
1871, . .	50.0	50.6	55.5	74.8	92.8	88.2	85.6	85.0	78.0	73.1	62.0	43.3	92.8
1872, . .	42.9	50.0	44.0	84.0	84.1	91.8	91.7	88.8	88.5	69.0	54.0	40.3	91.8
1873, . .	42.3	45.0	49.3	66.2	82.0	90.0	92.4	86.2	85.8	70.5	52.0	57.7	92.4
1874, . .	52.0	49.3	57.2	63.0	86.0	93.0	90.0	84.0	85.8	66.0	60.0	49.0	93.0
1875, . .	35.5	50.0	51.0	63.0	84.7	89.0	91.5	84.8	84.7	70.3	56.2	55.0	91.5
1876, . .	63.0	52.3	59.0	63.3	86.0	87.7	95.0	90.0	90.0	71.1	71.7	42.0	95.0
1877, . .	43.0	50.0	52.8	75.8	84.5	88.0	89.1	87.4	85.7	75.4	66.8	55.2	89.1
1878, . .	44.4	53.3	65.1	73.1	83.2	90.2	92.2	83.3	84.5	77.3	57.2	53.7	92.2
1879, . .	50.1	43.2	51.6	72.4	83.0	90.3	91.4	90.6	85.6	82.6	68.2	54.5	91.4
1880, . .	47.9	57.6	59.8	77.7	93.0	91.1	90.5	88.0	90.0	71.4	59.2	38.9	93.0
1881, . .	38.0	47.0	50.8	78.4	89.0	80.0	87.2	90.8	94.0	86.2	66.7	61.4	94.0
1882, . .	45.0	47.4	56.2	68.0	78.0	90.0	92.1	93.0	87.7	73.8	66.1	48.0	93.0
1883, . .	42.2	43.1	51.1	67.3	89.0	90.8	93.0	86.2	79.8	77.1	67.2	53.1	93.0
1884, . .	40.1	46.0	54.0	70.3	85.2	92.5	93.0	92.4	90.0	78.2	61.0	57.4	93.0
1885, . .	57.0	39.0	50.0	83.0	85.0	89.0	93.0	87.0	81.0	80.0	70.0	65 0	93.0
1886, . .	56.0	52.0	61.0	83.0	82.0	82 0	95.0	90.0	83.8	77.9	65.5	49.0	95.0
1887, . .	47.2	43.8	46.0	74.4	86.5	91.0	93.6	88.0	80.0	74.4	64.8	51.0	93.6
1888, . .	41.0	49.0	49 0	84.0	80.0	94.5	85.5	87 0	76.0	66.0	71.0	56.5	94.5
Mean, .	45.5	47.9	56.3	73.0	83.2	88.6	90.7	87.2	83.2	72.9	62.1	48.9	91.9

Record of the Minimum Temperature from 1838 to 1888, inclusive.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1838, . .	6.0	-5.5	4.0	17.0	30.0	43.0	50.0	41.0	38.0	27.0	3.0	-7.0	-7.0
1839, . .	-13.0	0.0	4.0	22.0	27.0	40.0	49.0	44.0	34.0	22.0	11.0	-2.0	-13.0
1840, . .	-21.0	-14.0	7.0	19.0	34.0	44.0	50.0	50.0	36.0	23.0	18.0	-2.0	-21.0
1841, . .	-17.0	-6.0	8.0	21.0	29.0	43.0	42.0	42.0	46.0	20.0	13.0	5.0	-17.0
1842, . .	-10.0	5.0	13.0	17.0	30.0	34.0	49.0	45.0	30.0	26.0	13.0	-2.0	-10.0
1843, . .	-8.0	-15.0	7.0	15.0	35.0	34.0	47.0	53.0	30.0	28.0	17.0	2.0	-15.0
1844, . .	-22.0	-10.0	5.0	14.0	33.0	42.0	40.0	46.0	26.0	25.0	3.0	-5.0	-22.0
1845, . .	0.0	-3.0	8.0	24.0	30.0	41.0	46.0	42.0	32.0	17.0	12.0	-10.0	-10.0
1846, . .	-1.0	-6.0	2.0	22.0	32.0	41.0	44.0	47.0	37.0	25.0	20.0	1.0	-6.0
1847, . .	4.0	-8.0	9.0	5.0	34.0	42.0	46.0	48.0	35.0	15.0	5.0	3.0	-8.0
1848, . .	-12.0	-2.0	4.0	25.0	32.0	39.0	49.0	44.0	31.0	28.0	11.0	-3.0	-12.0
1849, . .	-8.0	-10.0	12.0	21.0	32.0	39.0	45.0	50.0	37.0	29.0	25.0	3.0	-10.0
1850, . .	-2.0	-11.0	8.0	19.0	31.0	44.0	48.0	44.0	32.0	23.0	16.0	-15.0	-15.0
1851, . .	-5.0	-8.0	12.0	24.0	30.0	41.0	49.0	39.0	29.0	31.0	13.0	-15.0	-15.0
1852, . .	-15.0	-3.4	0.3	23.3	38.5	43.9	55.0	48.9	33.0	24.3	15.0	6.1	-15.0
1853, . .	-2.5	0.5	7.6	27.4	31.8	39.0	54.0	45.9	37.0	24.9	13.8	7.2	-2.5
1854, . .	-9.6	-4.8	14.0	23.7	34.0	39.8	57.7	50.8	33.8	27.0	14.0	-9.0	-9.6
1855, . .	10.7	-16.0	7.8	17.0	41.5	48.0	57.2	44.7	33.0	30.2	15.0	7.0	-16.0
1856, . .	-7.5	-11.0	-9.0	16.5	38.2	48.0	55.9	48.2	41.8	25.0	18.0	-7.0	-11.0
1857, . .	-18.2	-2.7	7.0	14.3	39.8	49.0	55.5	53.6	32.0	25.0	13.0	2.2	-18.2
1858, . .	0.0	-5.0	-8.0	28.5	40.3	51.0	58.5	58.8	37.0	31.5	14.6	0.0	-8.0
1859, . .	-19.4	2.8	3.5	28.7	43.9	45.0	53.0	47.4	41.0	24.8	24.0	-8.5	-19.4
1860, . .	-8.0	-7.2	22.8	23.1	38.9	52.0	53.0	49.1	32.0	28.0	15.0	-7.0	-8.0
1861, . .	-17.0	-20.0	5.5	18.2	33.0	51.0	56.7	48.5	41.6	25.0	17.0	-6.5	-20.0
1862, . .	0.0	-2.0	13.8	24.3	44.0	49.5	51.9	48.0	39.0	26.0	18.0	-1.3	-2.0
1863, . .	5.0	-9.0	-6.0	25.0	38.3	51.0	55.3	48.7	32.0	21.0	18.0	3.2	-9.0
1864, . .	-1.5	-4.3	15.0	31.8	40.0	47.3	53.9	54.8	41.0	28.5	10.8	18.0	-4.3
1865, . .	-4.5	-1.0	13.0	33.0	42.8	55.9	54.8	47.5	35.0	24.2	18.5	6.8	-4.5
1866, . .	-14.5	-1.5	11.5	30.0	40.0	48.0	55.0	48.0	35.5	26.5	16.8	-3.8	-14.5
1867, . .	-5.0	8.0	8.0	29.0	36.0	54.0	55.3	48.3	39.0	27.0	17.5	-3.0	-5.0
1868, . .	0.0	-18.3	-7.3	23.0	36.0	51.8	61.0	51.0	36.2	19.2	23.8	-5.0	-18.3
1869, . .	3.0	-1.0	-9.0	26.7	35.2	47.4	53.5	50.0	36.3	26.8	16.9	-7.5	-9.0
1870, . .	5.0	6.2	6.5	35.0	42.8	53.5	54.5	47.0	40.0	26.0	24.7	1.0	1.0
1871, . .	-5.5	-9.5	24.8	27.0	41.0	51.8	54.0	50.0	32.0	24.3	7.0	-6.5	-9.5
1872, . .	2.5	-2.5	-4.8	29.0	43.7	48.7	59.1	52.9	39.5	29.9	10.0	-8.0	-8.0
1873, . .	-22.0	-2.5	1.8	33.5	39.0	50.6	56.1	49.1	36.2	27.0	6.5	7.0	-22.0
1874, . .	1.2	-5.0	9.7	18.7	39.0	51.3	38.0	46.3	39.0	28.5	16.0	0.0	-5.0
1875, . .	-8.2	-4.0	0.0	22.5	39.8	48.5	53.8	32.0	32.5	26.0	-1.0	-9.0	-9.0
1876, . .	2.8	-1.0	4.5	28.0	39.0	47.0	52.5	49.0	41.2	23.0	18.9	-1.0	-1.0
1877, . .	-3.5	8.5	10.0	32.5	40.0	54.7	58.1	54.8	39.0	25.3	19.4	13.0	-3.5
1878, . .	12.5	-3.2	13.2	37.0	40.5	46.4	55.2	49.9	37.0	27.0	19.8	11.7	-12.5
1879, . .	-4.5	1.0	7.0	32.7	40.0	49.0	56.7	53.2	30.4	20.8	7.7	-6.0	-6.0
1880, . .	2.0	-11.5	13.7	26.2	37.0	51.0	54.0	45.7	39.1	22.9	9.5	-5.0	-11.5
1881, . .	-12.4	-7.0	24.4	22.1	37.0	47.7	59.2	56.7	49.0	29.0	14.0	8.5	-12.4
1882, . .	-15.0	-6.0	17.4	23.7	39.1	52.2	56.3	49.7	43.7	32.2	12.0	0.0	-15.0
1883, . .	-2.5	-1.3	3.0	23.5	43.0	53.7	55.0	43.4	36.2	23.2	18.0	-12.8	-12.8
1884, . .	-8.0	5.1	0.0	31.2	37.6	50.0	57.1	48.8	39.0	26.5	19.8	-10.0	-10.0
1885, . .	-18.0	-15.0	-11.0	19.0	21.0	35.0	41.0	34.0	27.0	24.0	11.0	6.0	-18.0
1886, . .	-22.0	-11.0	-1.0	21.0	29.0	40.0	41.0	39.0	31.6	17.0	15.9	0.8	-22.0
1887, . .	-22.2	-3.8	-2.4	17.1	33.2	38.5	56.0	42.5	29.5	17.0	11.0	-6.0	-22.2
1888, . .	-21.5	-19.0	-3.0	15.0	26.0	38.0	46.0	42.0	25.0	26.0	5.7	3.5	-21.5
Mean, .	-7.4	-5.3	6.0	23.6	36.1	45.9	52.1	47.3	35.6	25.1	14.2	-1.3	-11.7

BULLETIN No. 154 JUNE, 1914

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

ALFALFA

By WILLIAM P. BROOKS.

This bulletin presents the author's estimate of alfalfa as a crop for Massachusetts farmers. It gives the results of both home and co-operative experiments to date, describes the methods of soil preparation, fertilization and seeding which seem likely to prove the most successful; discusses the principal obstacles to success, and the best methods of meeting them; and gives directions for the general management of the crop.

Requests for bulletins should be addressed to the

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Massachusetts Agricultural Experiment Station.

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CONTENTS.

ALFALFA.

Since the methods of producing this crop, and the conditions under which it promises to be successful are not yet generally understood, it is the plan to present in this paper first, a brief general discussion of the characteristics and value of the crop; second, the results of the most recent experiments on the station grounds; third, results obtained by farmers who have been growing the crop in co-operation with the station; and fourth, brief general directions based upon long-continued experiments for starting and managing the crop.

Characteristics and Value of Alfalfa.

Alfalfa is an exceptionally deep-rooted legume, and under the best conditions it is long lived. Like other legumes it has the capacity, under the right conditions, of assimilating nitrogen from the atmosphere, but until the root system and the nodules which it bears are well developed its growth is greatly promoted by the presence of readily assimilable nitrogen in the soil. It is without doubt one of the most valuable forage plants known to man. It has long been cultivated in various parts of Asia and Europe, whence it was brought to Mexico by the Spaniards, who took it with them to California and the semi-arid portions of our southwestern States. During the past fifteen or twenty years its culture has been steadily pushed eastward, and it is now successfully grown in most parts of the United States and in a few parts of Canada. In many essentials and in feeding value alfalfa resembles the clovers; and as these are so generally known its characteristics will be perhaps best brought out by comparison.

ALFALFA COMPARED WITH CLOVERS.

Longer Lived. — Alfalfa is a perennial, while individual plants of the red and alsike clovers, as a rule, live but two years. In regions without excessive rainfall, and in soils richly stocked with lime and thoroughly well drained, a stand of alfalfa is more permanent than a stand of clover under conditions existing in Massachusetts, but in this connection it is important to recognize two facts: —

1. That alfalfa in our soils and in our climate is much less permanent than in the west.[1] Experience everywhere indicates that the probability is that alfalfa will be gradually crowded out here by perennial grasses and clovers, most prominent among which are the Kentucky blue grass and white clover.

2. That it is possible to retain red and alsike clovers in permanent mowings without reseeding, provided a suitable system of top-dressing is followed.

Relative Yield. — Alfalfa grows more rapidly in early spring than either red or alsike clover, and starts more quickly after cutting, and accordingly it may usually be counted upon to give three crops during the season, whereas clover will usually give but two. The first cut of alfalfa is generally superior to either of the others. The total yield on good soils is likely to range from about 3 to 5 tons per acre of well-cured hay in the three cuttings, while red or alsike clovers on similar soils are likely to give about one-quarter less total yield in two cuttings.

Finer Stems. — The stem of the alfalfa plant is relatively finer than that of the red clover. It accordingly cures more rapidly and is usually more palatable, and is consumed with less waste than the coarser red or mammoth clover.

Nutritive Value. — It is popularly supposed, and quite generally stated, that alfalfa is much superior in nutritive value to clovers, but so far as can be determined by chemical analyses made in this station, and determinations of digestibility which have been made here in the department of plant and animal chemistry and in other stations, this does not appear to be the case.

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[1] The winter of 1913-14 has proved very destructive (see p. 170).

Composition of Clover and Alfalfa Hays.

	Number of Analyses.	Water (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fiber (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
Alfalfa hay,	4	13.24	6.38	13.98	28.48	34.70	1.40
Alsike clover hay,	8	15.00	9.70	14.00	23.10	36.10	2.10
Medium red clover hay,	15	15.00	7.70	13.30	24.30	37.20	2.50

Digestible Nutrients and Energy Values.[1]

	Protein (Pounds in 100).	Fiber (Pounds in 100).	Nitrogen-free Extract (Pounds in 100).	Fat (Pounds in 100).	Net Energy Value (Therms).
Alfalfa hay,	10.2	13.9	24.4	.5	34.9
Alsike clover hay,	9.2	11.6	23.8	.8	34.6
Medium red clover hay,	7.7	13.1	24.2	1.4	35.6

It will be noted that alfalfa is relatively somewhat richer in digestible protein than the clovers, but considerably lower in fat. The net energy values, or in other words the productive food values, of alfalfa and the clovers are shown by the trials reported to have been substantially equal.

Soil Improvement.

It has been recognized since the time of the Roman empire, and was perhaps even before that period, that the growth of clover improves the soil, and that all crops give superior results when following it. This knowledge of the facts profoundly affected farm practice many centuries before the peculiarly beneficial effects of clover could be fully explained. We now know that they are a consequence chiefly of two causes: —

1. The penetration of the subsoil by the vigorous root system, opening, mellowing and enriching it.

2. The assimilation of large amounts of atmospheric nitrogen a portion of which remains in the roots and stubble even when the crop is harvested and removed. In both these respects

[1] Based upon average results in the United States.

alfalfa under the best conditions excels the clovers. Its roots penetrate more deeply, and the total crop residue — root and stubble — is greater.

The Soil for Alfalfa.

Alfalfa will thrive on soils of many different kinds, but whatever the type it must satisfy certain conditions: —

1. It should have good depth and be rich, especially in the mineral elements of plant food. Medium loams, inclining rather to be somewhat heavy than light, will give the best crops. The soils which contain too large a proportion of clay retain so much moisture that in open winters the crop, especially when young, is liable to heave.

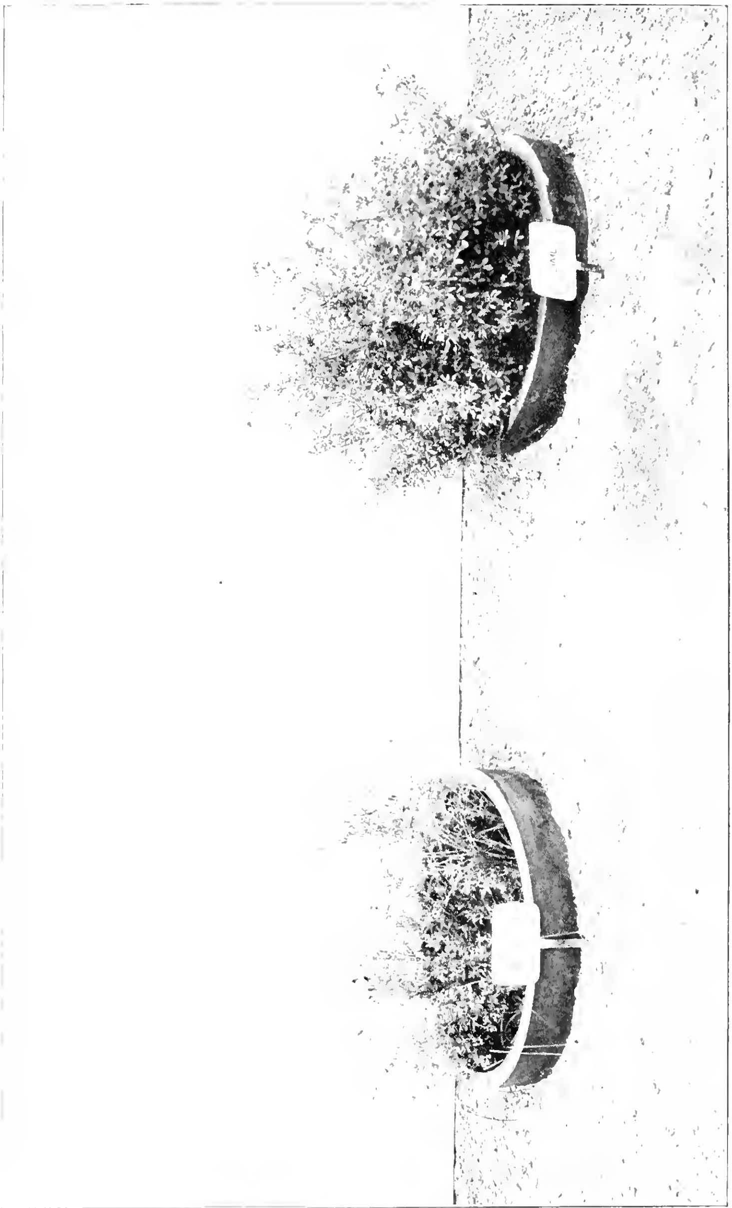
2. Stagnant water in the subsoil is highly injurious. In soils with good capacity to conduct and retain water the presence of standing water in the subsoil (determined by sinking trial holes) within less than 5 or 6 feet of the surface will be highly injurious. If the subsoil be free from standing water to much greater depth it will be a distinct advantage. In the case of soils of coarser texture, which do not conduct water freely in large quantities, and which have deficient capacity to retain water, the water table may be nearer the surface without disadvantage, but even with such soils it would, doubtless, be inadvisable to attempt the cultivation of alfalfa with standing water nearer than 4 or 5 feet below the surface.

3. The field must have sufficient surface slope to carry off water, and there must be no pockets which will retain water. In fields which are too level, or in pockets, the formation of ice on the surface is fatal to alfalfa. It is, of course, possible that in this climate ice may sometimes form on the surface, even on considerable slopes, but this is a danger which cannot be avoided, and it is least on slopes.

4. The presence of a hardpan within less than 10 or 12 feet of the surface, or an excessively compact subsoil, will prove unfavorable; so, also, will a shallow soil underlaid by rock.

5. The soil must not contain free acid, though if this condition exists at the start it can be corrected by the use of lime.

6. The richer the soil naturally is in lime the better suited it is likely to be for alfalfa.



7. Where sweet clover grows abundantly wild, and where the beech tree occurs in large numbers, alfalfa will usually do well. This is because both sweet clover and the beech are lime-loving plants, and in the case of the sweet clover, moreover, because the bacteria which give it capacity to assimilate atmospheric nitrogen are either identical with those essential for alfalfa or so closely related that they serve the purpose. Inoculation for alfalfa is, therefore, unnecessary in sections where sweet clover grows spontaneously in abundance.

Lime Necessary.

Alfalfa, as already stated, is a lime-loving plant. The soils in many parts of this State are relatively deficient in this element. In most localities, therefore, an application of lime is one of the most important steps in the preparation of a soil for alfalfa. The quantity absolutely necessary will usually range between $1\frac{1}{2}$ and 2 tons per acre; more will usually be beneficial. There are a number of different forms of lime which will serve the purpose. On the heavier soils freshly slaked lime, commercial hydrated lime or fine-ground quicklime will best meet requirements, since these forms of lime will both improve the mechanical condition and correct acidity. On the lighter soils, and especially if deficient in organic matter, air-slaked lime or fine-ground limestone may be preferable. The so-called agricultural limes, or waste lime, slaked in heaps at kilns will meet the requirements in most cases.

Manures or Fertilizers.

Manure. — While manure helps to give the soils the desired texture, and increases the proportion of humus, which may be beneficial, it usually carries weed seeds, and if applied shortly before seeding increases the difficulty of getting a good catch. The free use of manure will, moreover, be likely to increase the competition of grasses with the alfalfa, enabling these in a measure to gradually crowd the latter out. The application of manure in preparation for alfalfa is not recommended by the writer. On the other hand, a free use of manure for crops which precede alfalfa is desirable, especially on the lighter and poorer soils.

Potash. — Alfalfa, in common with clovers and other legumes, does well only when there is a liberal supply of potash in available forms in the soil. Potash fertilizers should be freely used in most cases in preparing for this crop. Potash in the form of sulphate, in the writer's experiments, appears much superior to potash applied in the form of muriate.[1]

Phosphoric Acid. — Although usually relatively less deficient in our soils as compared with the needs of alfalfa than lime and potash, it should be applied in some form, and among the different materials available basic slag meal seems usually to prove best, no doubt because it contains a large proportion of lime.

Nitrogen. — A large amount of nitrogen in the soil is not essential; from some points of view it is undesirable. To give the crop a good start, a fair amount of this element in available form in the soil is essential, but beyond that it is unnecessary and even harmful, — unnecessary because the alfalfa can draw nitrogen from the air, and harmful because it favors the grasses which may drive the alfalfa out.

Varieties.

There are a very large number of varieties of alfalfa now known. Many which may prove valuable have recently been introduced from Siberia by the South Dakota Experiment Station, but these are as yet insufficiently tested. There are but three kinds which deserve attention, known respectively as the common, the Grimm and the variegated.

Common Alfalfa. — This appears to be simply an unnamed strain. If from northern-grown seed, especially seed descended from generations of alfalfa grown in the north, it is fairly hardy and satisfactory.

Grimm. — A specially selected strain which originated in Minnesota; noted for hardiness and productiveness. It took its name from the farmer said to have been one of the most prominent in calling attention to the variety and promoting its dissemination. Comparative trials at this station and in many parts of the northern United States have indicated

[1] See page 157.

this variety to be superior in hardiness and in productive capacity to the common.[1]

Variegated Alfalfa. — This is said to be a cross between common alfalfa and yellow lucerne, a forage crop which is closely related to alfalfa. The flowers vary in color from yellow to greenish purple. This variety is said to be more hardy than ordinary alfalfa and adapted to poorer soils. Where either the common or the Grimm can be grown they are preferred to the variegated, which is characterized by decumbent growth, greater consequent tendency to lodge and lower feeding value. This variety has not been tested in the Massachusetts Experiment Station.

Obstacles to Success.

Diseases. — Relatively few diseases have proved troublesome in Massachusetts. The only important one is leaf spot, which is most injurious on newly sown areas. The spots, which usually appear first on the lower leaves of the plant, are yellow to dark reddish brown in color. Sometimes the lower leaves only are affected, in which case not much damage will be done, but in cases of bad infection, and under favorable weather conditions (hot, humid air and frequent showers), the trouble may spread rapidly; all the leaves turn yellow and gradually fall. In such cases the disease if unchecked greatly enfeebles the plants, and weeds, grasses or clovers tend to displace the alfalfa. No preventive treatment is known, but the disease can usually be checked and healthy growth re-established by cutting, and whether the alfalfa be young or old it should be promptly cut if the disease appears to be serious and rapidly spreading toward the upper leaves. If the field is newly sown and the crop only a few inches high the cutting should not be too close, and what is cut may be allowed to lie where it falls. If the new growth is not healthy the field should be recut. In the case of an established field the forage may be either made into hay or fed green.

Dodder. — This is a parasite characterized by abundant development of thread-like reddish-yellow stems, attached to

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[1] See page 156.

the stems of the alfalfa and bearing inconspicuous flowers of the same color. This parasite tends to spread rapidly; it renders the crop unpalatable. If noticed in the field it is best to cut the crop and burn it, plow the field and not put it into alfalfa again for a considerable number of years. Alfalfa dodder is not yet general in this State, and most energetic measures should be taken to exterminate it where it appears. If it shows in a field it is safe to conclude the seed of the dodder was mixed with the alfalfa seed. It is so fine it usually escapes detection by the average buyer. Dealers should be asked to guarantee alfalfa seed free from dodder. In cases of doubt samples of seed should be sent to the experiment station for examination.

Weeds. — Annual weeds will give but little trouble, provided such methods of seeding as are later recommended are followed. Especially is this true if the thorough preparatory tillage recommended when the seed is to be sown in late summer is followed. In the case of spring seeding, either with or without a nurse crop, annual weeds may compete with the alfalfa for water and food. If the growth is thick and rank the weeds may be clipped with a mowing machine set about 3 inches high. It is a mistake to sow alfalfa in fields heavily infested with the roots or seeds of perennial weeds. Especially is this true of witch grass, the competition of which alfalfa is wholly unable to withstand.

Grasses and Clovers. — In our better soils, and with our humid climate, some of the grasses and clovers, particularly Kentucky blue grass and white clover, tend to come in and gradually to crowd out the alfalfa. The tendency in this direction is increased by the use of barnyard or stable manures which, besides supplying large amounts of nitrogen (highly favorable to the growth of grasses), often carry their seeds as well as those of clover. It cannot be regarded as good practice to top-dress a well established field of alfalfa with manure of any kind. So doing, besides being objectionable from the points of view already stated, must be regarded as wasteful of nitrogen, the most costly plant-food element, since the alfalfa if well established is able to take this element so largely from the air.

It is possible, by the use of a harrow at the proper season, to in a measure check the coming in of grasses and clovers. These are more shallow rooted than alfalfa and may, therefore, be uprooted without much injuring the latter. A spring-tooth harrow properly set is the most effective type, and a special form of tooth has been designed for this particular use. This implement is advertised as the alfalfa harrow. Its use is most effective when the soil is relatively dry, and immediately after cutting either the first or the second crop will usually prove the best time for the operation.

Winterkilling. — Any one of the following causes may, under unfavorable conditions, destroy alfalfa: —

1. Heaving, which is most serious on the heavy soils. Tendency to this is much reduced by allowing a relatively heavy growth to remain in the field for winter protection. Perfect underdrainage, natural or artificial, of course lessens the tendency to heave, which is greater in proportion as the water content of the soil increases.[1]

2. Formation of ice on the surface. This is something which, under extreme weather conditions, may affect any field, but the tendency to this injury is comparatively small in fields where the slopes are such as to rapidly carry off surface water.

3. The presence of free acid in the soil, for this weakens the plant, rendering it susceptible to unfavorable conditions of any kind. The remedy is of course the application of lime.

4. Insufficient winter protection, due to too late cutting or excessive or overlate pasturing.

Recent Experimental Work with Alfalfa at this Station.

The more important of the recent experiments with alfalfa in this station have been as follows: —

1. Comparison of Grimm with the common alfalfa.

2. Comparison of high-grade sulphate with muriate as a source of potash.

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[1] Much alfalfa was killed during the year of 1913-14. The cause is not surely known; but it seems possible it was due in a measure to the large amount of water in the soil, owing to heavy fall and early winter rains (see p. 170).

3. Comparison of different methods of seeding.
4. A test of a commercial culture for inoculation.

In addition, we have had under constant observation a number of plots of different ages on which observations as to the gradual displacement of the alfalfa by grasses and clovers have been made.

1. *Grimm compared with Common Alfalfa.*

For a number of years it has been our object to make careful comparisons of the Grimm alfalfa with the common variety from northern-grown seed. Our first trials were begun in 1909, but although we obtained what we supposed to be Grimm seed of the very best quality from a grower recommended by the Minnesota Experiment Station, and believed to be absolutely reliable, our first experiments were a failure. There were no essential differences either in the appearance or the yield, and the party who furnished the seed later wrote us that a mistake had been made, that the seed sent as Grimm was not true to name. He supplied us, without charge, with seed of the genuine Grimm. This was sown after very careful preparation of the soil on a field where alfalfa had been previously grown in the late summer of 1911.

The land used in this experiment comprised two plots. Both have received annually for the past twenty-three years an application at the rate of 600 pounds per acre of fine-ground bone meal. One of the two plots has in addition annually received a liberal application of muriate of potash, for the last thirteen years at the rate of 250 pounds per acre; the other plot has annually received the same amount of actual potash, but in the form of high-grade sulphate, and for the last thirteen years at the rate of 250 pounds to the acre. Under both systems of manuring the Grimm alfalfa has given yields considerably larger than those obtained from the common. The results both for 1912 and 1913 are shown in the following table: —

Comparison of Varieties of Alfalfa and Source of Potash.

	Muriate of Potash.		High-grade Sulphate of Potash.	
	Grimm (Tons per Acre).	Common (Tons per Acre).	Grimm (Tons per Acre).	Common (Tons per Acre).
1912.				
1st cut,	2.122	1.56950	2.21875	1.98225
2d cut,	.465	.29075	.76925	.59150
3d cut,	.750	.63950	.94675	.82225
Totals,	3.337	2.49975	3.93475	3.39600
1913.				
1st cut,	3.08500	2.61600	2.94650	2.66250
2d cut,	.63935	.36045	1.00590	.71000
3d cut,	.40685	.29650	.57395	.50295
Totals,	4.13120	3.27295	4.52635	3.87545

The area of the plots used in these experiments is one-eighth acre each. The averages of both plots for the two years are: for the common alfalfa, 3.261 tons per acre; for Grimm alfalfa, 3.982 tons per acre, — a difference of about 22 per cent., greater yield in favor of the Grimm. In 1912 the yield of the Grimm alfalfa was 23 per cent. greater than that of the common. In 1913 both varieties yielded larger crops than in 1912, the yield of the Grimm being 21 per cent. greater than that of the common. The superiority of the Grimm as compared with the common is shown to have been no greater in the second year than the first. There is, therefore, no indication to date that the Grimm will prove more permanent than the other.

2. *Comparison of Potash Salts for Alfalfa.*

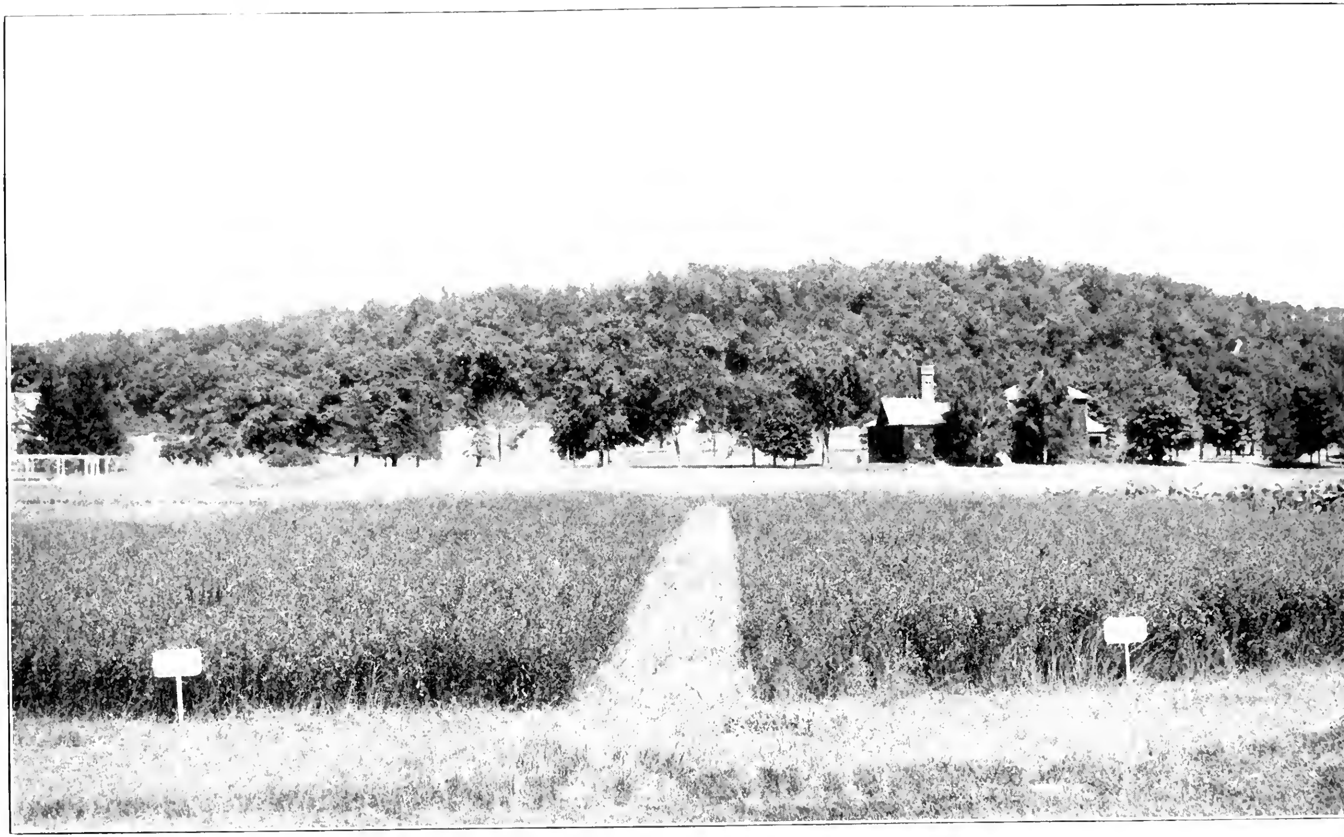
In one of the fields (Field B) of the experiment station grounds, the soil of which is a medium loam with compact and moderately clayey subsoil, alternate plots of one-eighth acre each have been continuously fertilized respectively with muriate and high-grade sulphate of potash in equal amounts for the past twenty-one years. These salts have been applied since 1900 at the rate of 250 pounds per acre each. Throughout the entire period (twenty-one years) these plots have each

had an annual application of fine-ground bone meal at the rate of 600 pounds per acre. Throughout this entire period no manure has been applied to the land, and no other fertilizer of any kind with the exception of lime. Hydrated lime at the rate of 2 tons to the acre was applied broadcast upon the rough furrow in April, 1910, and deeply worked in by the use of the disk harrow.

Two plots in this field were sown to common alfalfa on Aug. 2, 1910. The seed did not germinate well, and the growth being too thin the plots were plowed July 12 and reseeded Aug. 5, 1911. One-half of each plot was sown to Grimm alfalfa and one-half to the common northern-grown seed. The yields on the two plots are shown in the table, page 157. It will be noticed that in every case the yield obtained on the sulphate of potash has been materially greater than that obtained on the muriate. The average rates of yield per acre for the two years on the two potash salts have been as follows: —

	Muriate of Potash (Tons per Acre).	Sulphate of Potash (Tons per Acre).
Grimm alfalfa,	3.734	4.231
Common alfalfa,	2.886	3.636

Whenever the crop is in active growth (and this has been true almost ever since the little seedlings appeared above the surface) there is a striking difference in the shade of green of the foliage on the two potash salts. The leaves on the sulphate of potash plots are of a much darker shade, which would be characterized as dark green. Those on the muriate of potash plots are much lighter. The shade would be characterized as yellowish or pea green. A similar difference in shade of foliage has been noticed in the case of other plants when grown on these potash salts. It is believed that this indicates a difference in character or number of the chlorophyl bodies of the two types of plants, — a difference which we have not, however, been able to demonstrate by scientific tests, but which apparently gives the chlorophyl bodies of the darker green plants a higher degree of functional activity.



Bone and muriate. Bone and sulphate.

3. *Spring and Summer Seeding compared.*

In the spring of 1910 a small area of silt loam soil, underlaid by gravel at the depth of 4 or 5 feet, was selected for the purpose of comparing the results of seeding in early spring with a nurse crop with the results of seeding in summer after bare fallow with sufficiently frequent harrowing to keep down weeds. The soil in question had been used during a number of years for a variety of crops including potatoes, corn and a test of varieties of alfalfa. Previous crops had been raised on fertilizers. No manure had been applied for many years. The soil contained a great many seeds of annual weeds, but it was not infested with the roots of perennial weeds. The entire field was limed on May 19 at the rate of $1\frac{1}{2}$ tons agricultural lime. On one-half of the field fertilizers at the following rates per acre were applied and harrowed in: —

	Pounds.
Basic slag meal,	1,500
High-grade sulphate of potash,	350
Nitrate of soda,	125

The spring sowing was made on May 19, with oats at the rate of 1 bushel per acre as a nurse crop. Fertilizers were applied to the other half on July 1, and the summer sowing was made on August 1.

From the spring-sown plot a fair crop of oats (somewhat mixed with weeds) was harvested in July, and in addition from this plot on September 21 was harvested a crop of alfalfa hay at the rate of 1.41 tons per acre. The yields from the two plots in the following year were as follows: —

Spring-sown alfalfa at the rate of 3.44 tons per acre.

Summer-sown alfalfa at the rate of 3.34 tons per acre.

From the statements so far made the conclusion must clearly be that the spring sowing had distinct advantages over summer sowing. We have first to its credit a fair crop of oat hay and a moderate crop of alfalfa the season of sowing; and second, the yield the following year was slightly greater than on the summer-sown alfalfa. There is, however, one point connected with the results distinctly unfavorable to the spring sowing, viz., the proportion of weeds in the product

was much greater than in the crop from the summer sowing. The weeds were not separated from the alfalfa the first year, and during the second year only from the second cutting. The method followed was this: just previous to the second cutting, one square yard in each plot, which seemed as a result of careful examination to be fairly representative in both cases, was selected, and the entire product cut and separated into three classes, viz., alfalfa, grass and clover, and weeds. The results reduced to a percentage basis are shown in the following table: —

	Spring-sown Alfalfa (Per Cent.).	Summer-sown Alfalfa (Per Cent.).
Total weight,	100	100.0
Alfalfa,	65	86.6
Grass and clover,	15	1.6
Weeds,	20	11.6

4. *Inoculation.*

Two experiments in inoculation by the use of a commercial culture have been tried. The first was upon land fertilized annually for a long series of years with bone meal at the rate of 600 pounds, and muriate of potash at the rate of 200 pounds, per acre (Field D). The land had been used for a considerable variety of crops. No alfalfa had previously been grown on it.

The soil is a medium loam with a compact subsoil containing considerable clay. The culture employed was Farmogerm [1] and it was used, in accordance with directions, for the treatment of the seed before sowing. In preparation for the crop the soil received an application of lime applied to the rough furrow (and deeply worked in) at the rate of 3,500 pounds per acre. The grade of lime used was a so-called agricultural lime containing some hydrate, but mostly in the form of carbonate. The land also received a mixture of fertilizers at the following rates per acre: —

[1] Farmogerm is made by the Earp-Thomas Farmogerm Company, Bloomfield, N. J. There are now numerous other commercial cultures on the market, and numerous colleges and experiment stations (this one among them) are now furnishing cultures for all legumes at cost to citizens of their respective States. No effort to compare the different cultures has been made in this station.

	Pounds.
Basic slag meal,	1,500
Muriate of potash,	500

This was deeply harrowed in. In addition, just previous to the last harrowing, a mixture of equal parts of nitrate of soda and fine-ground bone was applied at the rate of 500 pounds per acre.

The treatment of the soil brought it into a condition believed to have been highly favorable to bacterial activity; and the preparatory tillage had been such that it was moderately compact below, with the surface in fine mechanical condition and mellow. The seed was sown July 29. It germinated well and the ground was well covered, the crop being some 10 inches or more in height before cold weather set in.

The second experiment was upon a somewhat lighter soil (North Field) which would be characterized as a silt loam, underlaid with gravel of moderately open texture. This land had been annually manured for a considerable number of years with well-preserved manure from dairy cows. The rate of application had been moderately heavy. It had been used for a variety of forage crops in rotation, but no alfalfa had been grown upon it.

The preparation of the land and the general treatment were very similar to those in the other experiment. Lime was applied at the rate of 4,000 pounds per acre, basic slag meal at the rate of 600 pounds, and muriate of potash at the rate of 800 pounds per acre, and these were deeply incorporated with the soil by the use of the disk harrow. Just before seeding, a mixture of nitrate of soda and fine-ground bone meal in equal parts was applied at the rate of 400 pounds per acre. The seed was sown July 27, and as in the other field germination was perfect, and the ground well covered with abundant growth for protection during the first winter.

The seed used in both experiments was of two kinds: Montana-grown common alfalfa, and a variety which had been purchased under the name Grimm but which was later found not to have been true to name. It was, however, like the other, northern-grown seed; and the crops from the two kinds of

seed showed no appreciable differences. The rates of yield are shown in the following table: —

	Field D.			North Field.		
	Inoculated (Tons per Acre).	Uninoculated (Tons per Acre).	Gain per Acre.	Inoculated (Tons per Acre).	Uninoculated (Tons per Acre).	Gain per Acre.
1910.						
1st cut,	2.33	1.97	.355	2.70	2.44	.257
2d cut,	1.02	.88	.140	1.63	1.54	.090
3d cut,	1.43	.98	.450	1.41	1.39	.020
Totals,	4.78	3.83	.945	5.74	5.37	.367

It will be noted that in both experiments there was considerable gain due, in so far as can be judged, to the use of the culture. An examination of the roots at a number of different points in the early spring of 1910 showed, however, that there were nodules on the uninoculated as well as on the other, and in both cases by the end of the season there was no difference which could be detected by close observation in the appearance of the inoculated and uninoculated plots. In 1911 the growth of the uninoculated was fully equal to that of the inoculated, and the weights were not separately taken. The value of the increase in the yield the first year, supposedly due to the inoculation, was, however, much greater than the cost of the culture ($2 for an acre) and the labor entailed in using it. The conclusion appears, therefore, to be justified that when alfalfa is put upon land on which the crop has never been grown the use of a commercial culture is likely to be profitable.

The rates of yield per acre on these fields in succeeding years are of interest in this connection. They show conclusively that on suitable soils rightly managed alfalfa is a valuable crop. The yields are shown in the following table: —

	Field D (Tons per Acre).	North Field (Tons per Acre).
1911,	2.72	2.80
1912,	2.99	3.58
1913,	3.89	4.97

The manurial treatment previous to the introduction of alfalfa in these fields, and the kinds and amounts of materials applied in preparation for the crop, have been given. Subsequent fertilizer treatment has been as follows: —

Field D. — From 1910 to 1912, inclusive, this was annually top-dressed with bone meal at the rate of 600 pounds, and muriate of potash at the rate of 200 pounds, per acre; and in 1913 the rate of top-dressing was basic slag meal 1,000 pounds, muriate of potash 200 pounds, per acre.

North Field. — This field received no top-dressing in either 1910 or 1911, but in 1912 and 1913 it was top-dressed with basic slag meal at the rate of 1,000 pounds, and sulphate of potash at the rate of 100 pounds, per acre.

In both fields the alfalfa is now considerably mixed with grasses, principally Kentucky blue grass and white clover. The yield, however, on both is still very large, and as both Kentucky blue grass and white clover rank exceptionally high in nutritive value the quality of the hay, though not pure alfalfa, is still much above the average in feeding value. An effort has been made to diminish the proportion of grass and check its spread in the North Field by thorough disking. This operation was carried out in the summer of 1912, immediately after the harvesting of the second crop. The result was a very material improvement.

Co-operative Experiments with Alfalfa

In Part I. of the twenty-third annual report the plans for the co-operative experiments now to be discussed were fully reported. These experiments were 33 in number. They were quite evenly distributed throughout the State, and were located on farms belonging to men especially recommended as well fitted for such work. The experiment station furnished the best obtainable seed. The soil was thoroughly prepared, the seed was inoculated with Farmogerm[1] and sown in the late summer of 1910. Three reports have been made by the farmers co-operating in this work.

The first of these reports was published in Part II. of the twenty-fourth annual report. This had reference to the conditions about the middle of May in 1911. Twenty-nine

[1] See page 160.

written reports only were received. The results may be classified as follows: successful experiments, 13; partially successful, 9; failures, 7.

Two other reports direct from the farmers have since been received: the first of these, made during the winter of 1912–13; the second, during the winter of 1913–14. On each occasion there was a diminished number of farmers responding, indicating, no doubt, failure on the part of most of those who did not report. The number of growers reporting in the winter of 1912–13 was 24. Of these, 6 were entirely successful, 8 partially successful and 10 had experienced failure.

At the time of the last report, in the winter of 1913–14, only 9 growers responded. Of these, 5 were successful, 1 partially successful and 3 had experienced failure.

The results obtained might be considered discouraging but for the fact that the causes of failure in most cases would seem to be avoidable. These causes, in the order of their importance, may be classified as follows: —

1. *Winterkilling.* — This appears to have been due in most cases to poor drainage or to too flat a surface, permitting standing water and ice. In some cases winterkilling seemed to be a consequence either of the fact that the seed was sown too late, or that the weather immediately following sowing was so dry that the crop did not get a good start. As a consequence of either of these conditions the first winter found the crop with insufficient growth for protection.

In other cases winterkilling was a consequence, also, of insufficient winter protection, but this was due either to the fact that the alfalfa was pastured too late in the fall or that the last cutting was made too late.

2. *Weeds and Grasses have crowded the Alfalfa out.* — This has occurred mainly on fields which either did not get a good start in the beginning, owing to imperfect germination of the seed, or on fields which were partially winterkilled, thus giving weeds and grasses opportunity to come in.

In some cases, however, the competition both of weeds and grasses with the crop has been accentuated by the use of manure as a top-dressing.

Among all the different weeds and grasses mentioned as

crowding out alfalfa, witch grass is the one most frequently mentioned. It is perfectly clear that sowing alfalfa in land infested with witch grass is highly unwise.

Yield obtained. — The range of yields in the successful experiments as reported by the growers (in part estimated) is from 1 to 6 tons per acre. This wide variation reflects the extreme differences in character of soil as regards physical characteristics and fertility, and also, no doubt to some extent, the difference in thoroughness in the work of the different farmers concerned. The average yield per acre of the 7 growers who reported definitely is 3.2 tons.

The Dates of Cutting. — There has been considerable diversity of practice, in spite of the fact that very definite advice was given, in the dates of cutting. The range has been about as follows: the first cutting from June 17 to June 28; the second, July 20 to August 20; the third, August 25 to September 25.

The Opinions of Growers. — The following is a list of the farmers who are co-operating in this work and a brief statement of their opinions as to the value of this crop for the section of the State in which they live: —

C. M. Cudworth (*Cummington*). — Consider it a profitable crop if clover and timothy can be kept out.

John H. Bartlett (*Nantucket*). — I think it is a valuable crop to raise. I am going to put in more this season.

Lovett Brothers (*Oxford*). — Have reseeded. New stand gives promise of a good crop.

C. W. Prescott (*Concord*). — The crop is holding its own and doing well considering that no plant food has been applied since planting. One-half acre seeded to Grimm has been a wonder.

Edward Kirkham (*Holliston*). — Crop has gradually died out. Shall not try it again on my heavy soil unless I do some tile draining.

Lyman P. Thomas (*Rock*). — Crop winterkilled because of the mistake made in pasturing too late.

Charles L. Clay (*North Dana*). — Still believe it to be a profitable crop if witch grass can be kept out.

Paul Cunningham (*Bolton*). — Crop was killed out by drought of 1911.

H. A. Parsons (*North Amherst*). — Results indicate crop to be valuable. Seeded 1⁶⁄₁₀ acres more.

Cyrus S. Bardwell (*Shelburne*). — Do not believe the crop is suited to this vicinity.

G. B. Trowbridge (*South Weymouth*). — The dry weather has a bad

effect upon alfalfa; at least it seemed to kill most of mine after the first crop was cut.

J. B. SAWYER (*Bradford*). — Crop suffered because of the severe drought in 1913.

HOWARD W. FOSTER (*Lowell*, R. F. D. No. 1). — Condition of the crop compared with a year ago is much better.

JOHN L. SMITH & SON (*Barre*). — If it were not for witch grass should sow the rest of the field.

H. K. HERRICK (*Blandford*). — Results obtained are encouraging. Shall try more.

SELECTION OF SEED.

The experiments described in earlier pages indicate that the Grimm [1] alfalfa is superior to the common, but the latter has given satisfactory results in many cases. Whatever the variety, it is important that northern-grown seed be selected for New England use; and not only that the seed purchased for sowing shall have been grown in the north, but it should be descended from as many generations as possible of northern-grown alfalfa. It will be wise, as already pointed out, to purchase only on guarantee that the seed is free from admixture with the seed of dodder.[2] Where this parasite becomes established success with alfalfa becomes impossible.

TIME AND METHOD OF SEEDING.

Alfalfa may be sown with success either in early spring with a nurse crop or late in summer with corn or alone. Sowing alone in late summer is attended with less risk than any other method.

Spring Sowing. — Alfalfa sown in spring will usually start well, but in order to keep down the annual weeds which are almost sure to be abundant in our better soils it is essential to put in a nurse crop; and at the season when this is cut the weather is frequently so hot and dry that the young alfalfa is seriously injured. When seeding in spring it is recommended that the quantity of alfalfa seed should be about 25 to 30 pounds per acre. Either oats or barley will serve best as a nurse crop, and about 1 bushel of either will be sufficient.

Seeding in Corn. — In some cases seeding to alfalfa in the standing corn according to the method of seeding to grass,

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[1] See page 156. [2] See page 153.

which is so commonly followed in the Connecticut valley has given successful results. This method, however, can be expected to succeed only when conditions are highly favorable. The soil must be one of fine texture, in perfect tilth, and naturally retentive of moisture. The corn field must be free from weeds, the corn must not be over thick, nor the growth excessively rank. If either of the last-named conditions exists the alfalfa will not make sufficient growth to go into the winter with adequate protection. If the corn is to be cut for the silo the alfalfa will be more likely to succeed than in field corn, for during the interval between the cutting of ensilage corn and cold weather it may make considerable growth. The best date for seeding in this manner is usually about the end of July. Showery weather should be selected if possible, and the quantity of seed should not be less than 30 pounds per acre.

Summer Seeding alone. — This method of seeding has given more uniformly successful results than any other which has been tried in the station or upon the college grounds; indeed, with proper preparation it has never failed. The following is a brief outline of the most successful practice: —

1. Plow the previous autumn, or in spring as early as the ground can be worked.

2. Apply a heavy dressing of lime to the rough furrow either in fall or early spring and disk in at once.

3. As early in the spring as weed seeds begin to germinate apply the following mixture per acre: basic slag meal, 1,500 pounds; high-grade sulphate of potash, 400 to 500 pounds; and disk it in.

4. Between the date of the last operation and the date of sowing the seed (which should not be later than the last of July) harrow about once in ten or twelve days.

5. When ready to sow the seed apply per acre nitrate of soda, 100 pounds, basic slag meal, 300 pounds, mixing them and harrowing in lightly.

6. Sow 25 to 30 pounds of seed per acre, inoculating it if alfalfa has not been successfully grown on the land before, and cover as you would grass seed.

7. Inoculation may be effected either by the use of a com-

mercial culture, a culture which will be furnished by the college, or the incorporation of soil from a successful alfalfa field with the soil of the field to be sown. Inoculation of the seed is usually least expensive and fully as successful as the use of soil, but if the latter method is adopted sow 300 or 400 pounds per acre. It should be spread (in cloudy weather if possible) and at once harrowed into the soil. Cultures are most effective when fresh. They gradually lose vitality on keeping, and in ordering, whether from a commercial house or the college, the date when the culture will be used should be specified.

8. However luxuriant and abundant the growth following summer sowing, whether in corn or alone, it will not be advisable in the severe climate of New England to cut or pasture the crop. Even if the growth be a foot to a foot and a half in height it is worth more left in the field, and will not interfere with the development of the crop or the harvesting thereof the following season.

Harvesting Alfalfa.

Whatever the stage of development alfalfa should be harvested as soon as the buds or suckers which start near the base of the plant are well developed. This will usually be when the alfalfa is in early bloom. If allowed to stand much beyond the period of early bloom the plants start slowly after being cut, and the total yield of the season will be relatively small. In every case, however, before cutting examine the stem close to the ground to determine whether the basal buds are starting to grow. Whenever the cutting of the crop is too long delayed the result is a decrease in the total yield of the season. The last cutting should never be so late that the crop will not make growth sufficient for winter protection, and experience leads to the conclusion that in this climate this should be at least some 6 to 8 inches in height.

After cutting, alfalfa should be allowed to lie, with possibly one turning, until it is wilted. It should then be put into windrows which, if the weather is bad, may need to be turned once, and later into cocks where it should be allowed to remain until cured. Hay caps should be used if possible. Should the time required in curing it exceed about five days the cocks

should be moved to avoid injury to the roots, and it is desirable, as in the case of clover (which is often similarly handled), to remove the caps and open or turn over the cocks on the morning of a good day, when it is judged to be sufficiently cured to be put in.

Top-dressing.

If the crop has been successfully inoculated, or if the nodules which have been referred to are abundant on the feeding rootlets of the alfalfa, it will not be necessary to top-dress with materials furnishing nitrogen, or at least if such materials are at all required (as may be the case upon soils which are naturally very poor and light) they should be used only in moderate quantities. If used freely, nitrogen stimulates the growth of grasses which, therefore, are all the more likely to crowd out the alfalfa. On the other hand, it is necessary in order to secure large crops that the mineral elements of plant food be accessible in abundance. If then the soil is not naturally richly stocked with phosphoric acid and potash these must be supplied, and the following mixture of materials is recommended annually per acre: basic slag meal, 800 to 1,200 pounds; high-grade sulphate of potash, 175 to 250 pounds; or low-grade sulphate of potash, 350 to 500 pounds. This mixture may be applied either in the autumn or in very early spring.

If basic slag meal is used as a source of phosphoric acid it is believed that a second application of lime will not be necessary, but if any other material is selected as the source of phosphoric acid a top-dressing with lime once in two or three years is likely to be beneficial.

Summary.

The following conclusions and advice appear to be warranted on the basis of the results obtained in the experimental work and practical experience of this institution: —

1. Alfalfa is superior to red and alsike clovers in holding the land longer, giving a somewhat greater average yield, and in fineness and palatability. The net energy value is about the same as that of good clover, but alfalfa hay is richer in protein and therefore better supplements corn silage, corn

fodder or corn and reduces the expenditure necessary for concentrated feeds.

2. Cultivation of alfalfa greatly improves the soil as a result, chiefly, of the deep penetration of its great tap roots and of the assimilation of atmospheric nitrogen which is left behind in large quantities in roots and stubble.

3. Alfalfa will thrive on almost all thoroughly drained soils, but the field should have considerable surface slope, and a soil rich in lime is best.

4. A heavy application of lime is in almost all cases necessary, usually from $1\frac{1}{2}$ to $2\frac{1}{2}$ tons at least.

5. On soils which are low in humus and relatively poor, one good application of manure plowed in is beneficial, but in general, fertilizers should be preferred to manure because less likely to bring in weeds, grasses and clovers.

6. The best source of potash for the crop is sulphate, and one of the best sources of phosphoric acid is basic slag meal.

7. The Grimm variety is superior.

8. Among the principal obstacles to success are leaf spot or rust, which can be prevented by cutting when it first appears; dodder, which can be avoided by care in the purchase of seed; the competition of weeds, grasses and clovers, which is reduced by avoiding manures or fertilizers rich in nitrogen; and winterkilling, which is due to poor drainage, formation of ice and insufficient growth for protection.[1]

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[1] Since this bulletin was written we have had opportunity to note the condition of alfalfa upon the station and college grounds in the spring of 1914. There is more winterkilling than for many years; and reports received from different correspondents indicate that the winter of 1913-14 has destroyed a large portion of the alfalfa in the State. A great deal appears to have been destroyed also in Connecticut.

The older seedings have in general suffered more than newly seeded areas, but in one case at least, reported by a large grower in Connecticut, the opposite was true.

The minimum temperature records were not exceptionally low, but from the middle of January until about the end of February the average temperature was low, and when lowest there was little snow protection. The principal known difference in conditions during the winter of 1913-14, and the winters of the recent years during which alfalfa has suffered little injury, was the higher proportion of water in the soil due to heavy autumn and early winter rains. It is the writer's belief that this was an important predisposing cause of injury. Alfalfa will endure extreme cold in relatively dry soils, but in soils containing a large proportion of water such temperatures subject its root system to most unfavorable conditions.

The Grimm variety has suffered far less than the common, even when the seed from which the latter was started was northern grown. In the light of existing conditions the writer's conviction is strengthened that our farmers will be wise not to depend too exclusively upon this crop. He would particularly urge that even although the seed be considerably higher in price, all farmers undertaking the growth of alfalfa should, for the present, plant Grimm variety, and as the demand for this seed is heavy and the price high he calls attention to the fact that there will be much temptation to substitute seed not true to name. The utmost care should be taken, therefore, to purchase only from parties known to be reliable.

9. The method of seeding attended with least risk is sowing alone in late summer after most careful preparatory tillage.

10. Inoculation of the seed is desirable when the crop is sown upon new land, and cultures used in accordance with directions are to be preferred to the use of soil in most cases.

11. In the co-operative experiments reported there is a large proportion of failures, but these appear to have been due to preventable causes, and the results are on the whole encouraging.

12. The crop should be cured with little exposure to direct sunshine and little handling to avoid loss of leaves.

13. It is a mistake to sow alfalfa in fields infested with witch grass.

14. The growth of weeds, grasses and clovers can be largely prevented by harrowing after the first or second cutting of any season when they are first present in noticeable proportion.

15. Annual top-dressing with slag meal and potash will in most cases be desirable.

BULLETIN No. 155 JULY, 1914

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

NEW FERTILIZER MATERIALS AND BY-PRODUCTS

By H. D. HASKINS

AND

COCOANUT MEAL

By J. B. LINDSEY

The first part of this bulletin gives a brief statement of the composition and use of some of the more recent fertilizing materials, as well as the fertilizing value of some local by-products. Information is furnished regarding each product mentioned as to its chemical composition and the manner in which it can be best used. Whenever the product is suitable for home-mixing purposes the amount that may be used to advantage per acre is specified. Whenever the product can best be applied by itself, information is furnished as to the best manner of balancing with other ingredients so as to obtain the maximum benefit.

The second part gives results of experiments to determine the digestibility of cocoanut meal as well as of experiments to determine its food value. It is apparently fully equal in nutritive value to gluten feed, and its use in moderation is favorable to the production of butter of firm texture.

Requests for bulletins should be addressed to the

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

Massachusetts Agricultural Experiment Station.

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CONTENTS.

COMPOSITION AND USE OF SOME OF THE NEW FERTILIZER MATERIALS; ALSO, FERTILIZING VALUE OF SOME LOCAL BY-PRODUCTS.

H. D. HASKINS.

In the large number of miscellaneous materials forwarded to the experiment station laboratory there occasionally appears a new fertilizing product or by-product of value to farmers living in the vicinity of the establishment which produces it. Oftentimes it may be a poorly balanced fertilizer, although if supplemented with chemicals or other fertilizing ingredients it may prove efficient. The large number of inquiries received regarding such products as sources of plant food would indicate the desirability of publishing a brief statement as to their use.

No. 1. Sheep Manure and Wool Waste.
No. 2. Wool Waste extracted of Grease (Sud Cake).

Analysis.

	No. 1.	No. 2.
Moisture,	4.99	44.80
Potassium oxide,	2.89	.37
Phosphoric acid,	.31	.03
Total nitrogen,	1.27	1.30
Water soluble nitrogen,	.51	.27
Active water insoluble nitrogen,	.30	.51
Inactive water insoluble nitrogen,	.46	.52
Approximate commercial value per ton,	$6 48	$4 00

Sheep Manure and Wool Waste (No. 1). — This manure, which is quite thoroughly dried, may be used at the rate of 4 to 5 tons per acre for corn; when used in seeding to grass,

this application should be supplemented by 500 pounds of basic slag phosphate. Some of the commercial sheep manures, particularly those from wool-carding establishments, often carry large quantities of noxious weed seeds.

Wool Waste extracted of Grease (Sud Cake) (No. 2). — This product would be more suitable for corn and to fit land for seeding to permanent meadows than for potatoes or other hoed crops. It can be used to advantage on all soils deficient in organic matter and humus. Five tons per acre may be used to good advantage for corn or seeding to grass. In addition it would be well to use 150 pounds of muriate of potash and 500 pounds of basic slag phosphate.

No. 3. Fine-ground Foreign Whale Guano.
No. 4. Rockweed.
No. 5. Crude Unground Garbage Tankage.

Analysis.

	No. 3.	No. 4.	No. 5.
Moisture,	-	15.66	64.89
Potassium oxide,	None	1.81	.11
Phosphoric acid,	9.90	.23	.81
Total nitrogen,	8.16	.60	.78
Water soluble nitrogen,	2.08	.09	.15
Active water insoluble nitrogen,	3.43	.15	.10
Inactive water insoluble nitrogen,	2.65	.36	.53
Approximate commercial value per ton,	$37 00	$3 35	$1 80

Fine-ground Foreign Whale Guano (No. 3). — Whale guano is quite similar in composition to dry ground fish. Its nitrogen availability is probably about 67.50 per cent., while that of fish averages about 70 per cent. The whale guano carries quite a high percentage of fat (13.82 per cent.), which will probably prevent its nitrogen from becoming as quickly available as that in fish scrap.

Rockweed (No. 4). — Rockweed may be used broadcast at the rate of 5 to 6 tons per acre, and thoroughly worked into the soil by means of a disk harrow. The use of lime with this material will ordinarily be found advantageous, — from one-

half to one ton per acre. The product carries but a small amount of phosphoric acid; the use, therefore, of 400 pounds of basic slag phosphate or acid phosphate per acre for crops such as corn and seeding to grass will usually be found both economical and effective. Rockweed may be used to advantage on any soil deficient in organic matter and humus. It is not a well-balanced fertilizer, however, and should ordinarily be supplemented by an application of some source of available phosphoric acid.

Crude Unground Garbage Tankage (No. 5). — Crude garbage tankage, undried and unground, is necessarily a coarse, slow-acting material; yet it has more than a local interest, as most of our cities having a population of 30,000 to 40,000 own municipal garbage-reduction plants, and a considerable tonnage of tankage is therefore annually produced. A considerable amount of this material is contracted for by the commercial fertilizer manufacturer who uses it as a conditioner in fertilizer mixtures after it has been dried and ground. In this condition it is, of course, worth much more as a fertilizer than in its crude state. Of late there has been considerable inquiry regarding the value of the product, and requests for analysis are not infrequent. In its natural state it may be worth cartage to farmers living in the vicinity of the plant. The product may be used like farm manures, — from 5 to 6 cords per acre would not be an excessive application. It should be thoroughly worked into the soil with a disk harrow, and ordinarily should be accompanied by an application of lime. From 400 to 600 pounds of basic slag phosphate and 100 to 150 pounds of muriate or high-grade sulfate of potash per acre should be used to supplement it.

No. 6. Calcined Phosphate.
No. 7. Calcium Cyanamid.
No. 8. Sewage Tankage.

Analysis.

	No. 6.	No. 7.	No. 8.
Moisture,	-	2.23	7.30
Potassium oxide,	.59	-	.03
Total phosphoric acid,	32.06	-	1.62
Available phosphoric acid,	26.32	-	-
Calcium oxide,	36.99	40.00	-
Iron and aluminum oxides,	6.66	-	-
Sodium oxide,	7.40	-	-
Total nitrogen,	None	14.33	5.26
Water soluble nitrogen,	None	12.99	.40
Active water insoluble nitrogen,	None	.41	2.38
Inactive water insoluble nitrogen,	None	.93	2.48
Approximate commercial value per ton,	$23 25	$54 45	$16 65

Calcined Phosphate (No. 6). — Calcined phosphate, as the name indicates, is a manufactured product, high calcination being a part of the process. It is represented to be made under the so-called Newberry-Fishburne process, which, briefly stated, is as follows: —

A 30 to 32 per cent. phosphate rock is mixed with 15 to 20 per cent. of an alkaline salt. The mixture is heated in rotary kilns to a high temperature. During the process most of the salt is volatilized. The resulting porous clinker is pulverized and ground to a fine condition suitable for a fertilizer. The product gives a mild alkaline reaction.

Unpublished results at the Ohio and Indiana Experiment stations indicate that this material furnished phosphoric acid in an available form. The writer has not heard of the product being generally quoted in the fertilizer trade, and its cost is therefore not known.

Calcium Cyanamid (No. 7). — Calcium cyanamid, now generally handled in the trade under the name cyanamid, although not a new product is but rarely used by the farmer except as a part of commercial mixed fertilizers in which it is now not infrequently used. It is said that most of it is now bought by the fertilizer manufacturers. In view, however, of the large

number of inquiries received concerning its nature, a short description may not be out of place.

Cyanamid is made by combining atmospheric nitrogen with calcium carbide at a high temperature, electricity being used as the heating agency. Two forms of cyanamid are now offered to the trade in this country, both being of a dark slate color. One is a fine powder, the other granular. The chemical composition of the two products seems to be about the same. The granular cyanamid possesses some advantages over the powdered form. It would be less dusty and disagreeable to handle, and probably could be used in larger proportions in mixtures with organic ammoniates and acid phosphates without causing loss of ammonia or serious reversion of the phosphoric acid. The nitrogen in cyanamid is largely soluble in water and in availability ranks well with sulfate of ammonia; it is not in the form of ammonia, however, but rather of an amide compound which is easily broken up in contact with water and becomes readily available in the soil. The product may be used as a quick-acting nitrogen source. Cyanamid may have an advantage over sulfate of ammonia in that it will not leave an objectionable acid residue in the soil as does the latter product. The residue left by cyanamid is a lime product which sooner or later will have a beneficial sweetening effect upon the soil. It would probably not be good practice to use more than 100 to 150 pounds of the cyanamid to the ton if the fertilizer mixture is likely to remain unused for a number of months. The free lime in the cyanamid will gradually cause a reversion of the soluble phosphoric acid. In the preparation of home-mixtures, which contain nitrate of soda, tankage, dry ground fish, blood, as well as other organic ammoniates, with acid phosphate and potash salts, a small proportion of cyanamid will be wisely included, as it favors the improvement of the mechanical condition of the mixture. It will aid materially in preventing the lumping of the fertilizer as well as the loss of nitrogen from the nitrate of soda under the influence of freshly prepared acid phosphate. These advantages will more than compensate any loss in the solubility of the phosphoric acid in the acid phosphate due to the action of the free lime in the cyanamid. This is particularly true if the proportion of cyanamid to the acid

phosphate is not greater than 1 to 8 or 10. Cyanamid should not be used in the same mixture with ammonium sulfate, as free ammonia will be liberated from the latter salt. It should prove a valuable source of quick-acting nitrogen for most crops, but is not recommended as a top dressing for grass. It will not be found injurious when applied unmixed at the rate of 200 pounds per acre as a source of part of the nitrogen for tobacco.

Sewage Tankage (No. 8). — Sewage tankage, as the name indicates, is a product recovered from sewage by means of the precipitation method. In the sample here reported the grease was extracted from the dried material, which was then ground to a good mechanical condition. The sample analyzed carried about 78 per cent. of organic matter. Products of this character vary greatly in composition, as two samples examined at this laboratory in 1912 showed only .32 per cent. nitrogen, the phosphoric acid running 6.67 per cent. and the potash .78 per cent. Such a product would be valued commercially at about $5.50 per ton.

It has not been found commercially profitable to extract the fat from sewage tankage. The unextracted material has a very slow action in the soil, and practical experience does not encourage its use.[1]

No. 9. Picker Dirt from Cotton Mill, Average of Three Analyses.
No. 10. Cocoa-shell Dust.
No. 11. Shoddy Dirt from Woolen Mill.

Analysis.

	No. 9.	No. 10.	No. 11.
Moisture,	6.95	11.09	4.95
Potassium oxide,	1.56	2.71	.68
Phosphoric acid,	.68	1.49	.20
Total nitrogen,	1.37	2.94	4.40
Water soluble nitrogen,	.24	1.04	.12
Active water insoluble nitrogen,	.27	.51	2.41
Inactive water insoluble nitrogen,	.95	1.39	1.87
Approximate commercial value per ton,	$5 50	$9 50	$11 00

[1] See Monthly Bulletin, State Board of Health, Vol. 8, No. 12, December, 1913.

Picker Dirt from Cotton Mill (*No. 9*). — Picker dirt varies somewhat in composition; 19 analyses made at this laboratory show the nitrogen to vary from 1.55 to 1.60 per cent., the potash from .48 to 1.62 per cent., and the phosphoric acid from .08 to .68 per cent. The average commercial value on the basis of these analyses would be $3.75 per ton. The product would be slow in action when incorporated with the soil. Probably the most economical manner of using the material would be to add it at frequent intervals to the manurial matter in the manure pit; when used in this way it would retain a large amount of liquid manure and prove of value both as an absorbent and as a direct furnisher of plant food. It would not be a suitable material to use in the stable gutters on account of the dust, which would have a tendency to irritate the air passages and lungs of animals, and also because of the danger in carrying the germs of contagious diseases. A moderate application of lime should be used on the soil with this product, also about 400 pounds of basic slag or acid phosphate and 100 pounds of high-grade sulfate of potash per acre. The material will be found better adapted to corn and seeding to grass than to most other crops, and may be used at the rate of three cords per acre. It should be plowed in.

Cocoa-shell Dust (*No. 10*). — Cocoa-shell dust carries considerably more plant food than do ground cocoa shells, testing nearly a per cent. higher in nitrogen and phosphoric acid. The material may be used at the rate of 1 ton per acre. It should be supplemented by an application of 100 pounds of muriate of potash and 300 pounds of basic slag phosphate or acid phosphate.

Shoddy Dirt from Woolen Mill (*No. 11*). — Shoddy dirt will be found to vary considerably in composition. It is not a well-balanced fertilizing material, as it carries too little potash and phosphoric acid in proportion to the nitrogen. It may be used at the rate of 3 tons per acre applied broadcast and thoroughly wheel-harrowed in. For corn and seeding to grass 800 pounds of lime, 500 pounds of basic slag or acid phosphate and 150 pounds of muriate of potash should also be used per acre. On poor soils 100 pounds of nitrate of soda may be used to advantage when seeding to grass.

No. 12. Lime Refuse from Manufacture of Lactic Acid.
No. 13. Lime Refuse from Bleachery Filter Bed.
No. 14. Lime Refuse from Tannery.

Analysis.

	No. 12.	No. 13.	No. 14.
Moisture,	46.00	16.87	35.93
Calcium oxide,	19.23	42.43	24.80
Magnesium oxide,	.44	1.30	3.10
Nitrogen,	.30	-	.42
Sulfuric acid (SO_3),	27.50	-	-
Carbonic acid (CO_2),	.98	34.00	4.44
Insoluble matter,	.68	-	16.37

Lime Refuse from Manufacture of Lactic Acid (No. 12). — Lime refuse from the manufacture of lactic acid would not be a fit material to use agriculturally until mixed with 200 or 300 pounds of limestone per ton of refuse. The raw product carries nearly one-half of one per cent. of free sulfuric acid, which would probably injure vegetation unless neutralized by the limestone. The value of the product would not be over $2 to $3 per ton at the farm. After receiving the application of limestone the product should be used the same as land plaster or gypsum, as most of the lime is present as sulfate.

Lime Refuse from Bleachery Filter Bed (No. 13). — This particular sample contained practically all of its lime in the form of carbonate. It gave only a slight reaction for chlorides. In ordinary practice it would be well to apply the material during late fall and allow it to remain exposed until spring, so that any injurious lime compounds that might be present would have a chance to oxidize before being mixed with the soil. It may be used in quantities up to 2 tons per acre on land in need of lime.

Lime Refuse from Tannery (No. 14). — Most of the lime in this sample was present as hydrated or slaked lime. The product carries nearly one-half of one per cent. of arsenic (As_2O_5). If the product be used in moderate quantities (2 tons per acre) this amount of arsenic would probably not prove

injurious to vegetation. It might, however, have a deleterious effect upon the beneficial soil bacteria. The sample has been submitted to the college bacteriologist, Dr. Marshall, who will later make some studies to decide this point. The opinion was expressed by Dr. Marshall that this small percentage of arsenic would not prove harmful when used as above specified.

In general, it might be said that these various refuse lime products, including the product from acetylene gas plants, may be used to advantage locally when they can be had for the hauling or at a small cost. It is usually the safest way to make the application of these products in the fall or winter, so as to allow a chance for the oxidation of any injurious compounds that may be present.

COCOANUT MEAL.

J. B. LINDSEY.

The cocoanut is the fruit of the cocoa palm (*Cocus nucifera*), growing in Ceylon, India, West and East Africa, the Philippine Islands, Brazil and Australia. It is valuable for its shell (which furnishes fiber), its oil and its meat. The milk in the inner part of the nut gradually becomes thick as the cocoanut ripens, and forms the meat of the nut. According to Ollech,[1] a typical ripe nut was found to consist of 30.45 per cent. of fiber, 19.59 per cent. of shell, and 49.96 per cent. of meat, and to weigh 1,133 grams. The oil is removed by pressure or by extraction by cooking with water, frequently at the place of production. The meat is shipped in a dry condition to Europe under the name of Kopra. The dry, unextracted meat (8 per cent. water) contains from 36 to 67 per cent. of oil.

The extracted meat is ground and furnishes the cocoanut meal used in animal feeding. When in normal condition it is light red to brown in color, has a nutty smell and taste, and is well liked by all kinds of farm animals.

The lot experimented with was secured from the Edible Oils Company of New York, who imported it.

1. Composition of Cocoanut Meal.

	Our Sample.	Average German Analyses.	Gluten Feed used in Experiment for Comparison.
Water,	9.00	10.50	10.40
Ash,	5.89	6.20	3.78
Protein,	19.35	21.40	23.37
Fiber,	8.64	14.70	6.82
Extract matter,	48.00	38.70	52.75
Fat,	9.12	8.50	2.88
Total,	100.00	100.00	100.00

[1] E. Pott, Handbuch d. Thierischen Ernährung, etc., Bd. III., p. 76.

Our particular sample contained rather less protein and fiber and more extract matter than the average of German samples. The latter, according to Kellner,[1] are sold on a guarantee of 18 per cent. protein and 12 per cent. fat. The gluten feed with which cocoanut meal is compared shows less ash and fat, rather more protein, and decidedly more starchy matter. The oil in the cocoanut meal very soon becomes rancid, and is converted largely into free fatty acids, giving a slightly unpleasant odor and taste.

2. Digestibility of Cocoanut Meal.

One experiment was conducted with two sheep, with the following results: —

	Our Sample.	Average German Analyses.	Gluten Feed for Comparison.
Dry matter,	-	80[2]	88
Ash,	64	-	88
Protein,	90	78	85
Fiber,	23	63	87
Extract matter,	87	83	90
Fat,	100+	97	81

Applying these coefficients to the analyses, we find the following amounts digestible in 2,000 pounds: —

	Cocoanut Meal (Our Sample).	Gluten Feed for Comparison.
Ash,	75.4	66.5
Protein,	347.6	397.2
Fiber,	40.4	118.6
Extract matter,	829.0	949.6
Fat,	187.4	46.6
Total,	1,479.8	1,578.5

It appears from the above results that the gluten feed furnishes about 100 pounds more digestible nutrients in 1 ton than the cocoanut meal. If, however, the fat in each case is con-

[1] Die Ernährung d. Landw. Nutzthiere, p. 359.
[2] Organic matter.

verted into its starch equivalent in the usual way, we find the cocoanut meal furnishes 1,705 pounds of digestible matter and the gluten feed 1,634 pounds. The cocoanut meal contains 88.4 therms of net available energy and the sample of gluten feed 82.7 therms. In case of gluten feed, Kellner requires a reduction of 10 per cent., making the therms 74.4 as against 88.4 for the cocoanut meal. It seems doubtful, however, to the writer if this 10 per cent. reduction is allowable. It hardly seems probable on the basis of composition and digestibility that the cocoanut meal would have a much greater nutritive value than would the gluten feed.

3. Feeding Experiment with Cocoanut Meal, 1911.

In order to test the relative efficiency of the cocoanut meal as compared with gluten feed as a component of a dairy ration, 10 cows were fed by the reversal method in periods of five weeks' duration. Hay and wheat bran constituted the basal ration to which were added definite amounts of either cocoanut meal or gluten feed.[1]

Table I. — *History of the Cows.*

Name.	Breed.	Age (Years).	Last Calf dropped.	Served.	Milk Yield (Pounds), Beginning of Trial.
Samantha,	Jersey-Holstein,	7	Aug. 15, 1910	Dec. 17, 1910	25
Amy,	Pure Jersey,	3	Sept. 20, 1910	Mar. 1, 1911	17
Gladys,	Pure Jersey,	7	Sept. 15, 1910	Aug. 14, 1911	21
May Rio,	Pure Jersey,	7	Dec. 5, 1910	Apr. 12, 1911	20
Betty,	Grade Jersey,	6	Oct. 22, 1910	Dec. 22, 1910	28
Betty II.,	Grade Ayrshire,	3	Dec. 8, 1910	Jan. 26, 1911	31
Fancy II.,	Grade Jersey,	3	Aug. 16, 1910	Dec. 22, 1910	18
Cecile,	Pure Jersey,	5	Nov. 1, 1910	Feb. 8, 1911	28
Ida,	Pure Jersey,	3	Sept. 5, 1910	Feb. 11, 1911	15
Red III.,	Grade Jersey,	5	Oct. 8, 1910	Dec. 14, 1910	28

[1] Cow Betty, being particularly thin, was given 1 pound of corn meal daily as a part of the basal ration in each half of the trial.

TABLE II. — *Duration of Trial, 1911.*

DATES.	Gluten Feed Ration.	Cocoanut Meal Ration.
January 6 through February 10, . .	Samantha, Amy, Gladys, May Rio, Betty.	Ida, Fancy II., Betty II., Cecile, Red III.
March 11 through April 14, . .	Ida, Fancy II., Betty II., Cecile, Red III.	Samantha, Amy, Gladys, May Rio, Betty.

An unusually long time elapsed between the two halves of the trial (four weeks). This was due to the fact that several cows in the herd suffered a severe attack of scours, the cause of which could not be determined. It naturally interfered with the accuracy of the trial, although all of the cows were in good condition when the second half started, March 11. They had shrunk, however, rather more in yield than they would have had they not suffered the attack. Cows Amy, Betty II., Cecile and Betty were particularly affected.

Care and Feeding of Animals.

They were kept in roomy stalls, carded daily and turned into a protected barnyard for three to five hours each pleasant day. They were fed twice daily; the hay was given some time before milking in the afternoon and the grain just before milking, while in the morning the grain was given just before, and the hay just after, milking. Water was supplied constantly by aid of a self-watering device.

Character of Feeds.

The hay was largely Kentucky blue grass with considerable sweet vernal grass and some clover (early cut). During the last half of the trial the supply of this grade of hay became exhausted, and a mixture of timothy, red top and clover was substituted. It was of very good quality, but not as appetizing as the other variety. The animals refused some of the coarser parts and showed a tendency to shrink in milk. The bran was of the spring variety, and the gluten feed of good quality.

Weighing the Animals.

Each cow was weighed for three consecutive days at the beginning and end of each half of the trial, before the afternoon feeding.

Sampling Feeds and Milk.

The hay was sampled at the beginning and end of each half of the trial in the usual way, as described in other experiments of this character. The grains were sampled daily and the samples preserved in glass-stoppered bottles and brought to the laboratory at the end of each half of the trial for dry-matter determinations and complete analyses.

The milk of each cow was sampled daily for five consecutive days on the first, third and fifth week of each half of the trial. The usual method of sampling was followed.

TABLE III. — *Analysis of Feedstuffs.*

	Water.	Protein.	Fat.	Nitrogen-free Extract.	Fiber.	Ash.
Hay,	9.97	8.04	1.71	44.47	30.84	4.94
Bran,	11.97	16.10	1.36	55.99	9.23	5.33
Gluten feed,	10.28	23.39	2.88	52.82	6.83	3.79
Cocoanut meal,	6.49	20.05	15.07	44.98	8.43	5.06
Corn meal,	12.89	8.69	3.31	72.07	1.78	1.25

TABLE IV. — *Total Rations consumed by Each Cow (Pounds).*

Gluten Feed Ration.

	Hay.	Bran.	Gluten Feed.	Corn Meal.	Cocoanut Meal.
Samantha,	908	140	140	-	-
Amy,	625	105	140	-	-
Gladys,	695	105	140	-	-
May Rio,	695	105	105	-	-
Betty,	900	105	140	35	-
Ida,	689	105	105	-	-
Fancy II.,	522	100	100	-	-
Betty II.,	690	175	140	-	-
Cecile,	689	138	138	-	-
Red III.,	797	140	140	-	-
Totals for herd,	7,210	1,218	1,288	35	-

TABLE IV. — *Total Rations consumed by Each Cow (Pounds)* — Concluded.

Cocoanut Meal Ration.

	Hay.	Bran.	Gluten Feed.	Corn Meal.	Cocoanut Meal.
Samantha,	790	140	-	-	140
Amy,	514	99	-	-	133
Gladys,	624	105	-	-	140
May Rio,	672	105	-	-	105
Betty,	711	105	-	35	140
Ida,	764	105	-	-	105
Fancy II.,	481	105	-	-	105
Betty II.,	746	175	-	-	140
Cecile,	793	140	-	-	140
Red III.,	840	140	-	-	140
Totals for herd,	6,935	1,219	-	35	1,288

TABLE V. — *Average Daily Ration consumed per Cow (Pounds).*

CHARACTER OF RATION.	Hay.	Bran.	Gluten Feed.	Cocoanut Meal.	Corn Meal.
Gluten feed,	20.6	3.48	3.68	-	1[1]
Cocoanut meal,	19.8	3.48	-	3.68	1[1]

The cows averaged .8 of a pound of hay more daily while on the gluten feed ration. This may have been due to the presence of the extra oil in the cocoanut meal satisfying the appetites. The different animals received from 16 to 26 pounds of hay, from 3 to 5 pounds of bran and from 3 to 4 pounds of gluten feed or cocoanut meal daily.

TABLE VI. — *Digestible Organic Nutrients in Average Daily Rations (Pounds).*

CHARACTER OF RATION.	Protein.	Fiber.	Extract Matter.	Fat.	Total.[2]	Nutritive Ratio.
Gluten feed,	2.10	4.13	8.70	.32	15.95	1:6.5
Cocoanut meal,	1.92	4.00	8.12	.75	15.69	1:7.2

[1] For cow Betty only; not included in figuring average digestible nutrients.

[2] Including fat $\times$ 2.2.

It would appear, on the basis of the above calculations, which were made by applying average digestion coefficients to average daily rations consumed, that the two herds received substantially like amounts of total digestible nutrients. The cocoanut meal ration contained rather more fat and somewhat less extract matter than the gluten feed ration.

Herd Gain or Loss in Live Weight (Pounds).

Character of Ration.	Loss.
Gluten feed,	8
Cocoanut meal,	79

The difference is not of great importance. During the gluten feed period the 10 cows showed a total loss of 8 pounds, and during the cocoanut meal period a loss of 79 pounds. Cows Cecile and Betty II. were milking their maximum while in the cocoanut meal period, which took some flesh from their bodies.

Total Yield of Milk Products (Pounds).

Gluten Feed Ration.

	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent (Fat+1/6).
Samantha,	876.3	24.8	135.74	54.59	63.69
Amy,	608.8	17.4	91.81	35.55	41.48
Gladys,	731.8	20.9	112.99	44.93	52.42
May Rio,	741.8	21.2	111.72	43.84	51.15
Betty,	902.8	25.8	128.65	45.05	52.56
Ida,	447.8	12.8	75.95	32.60	38.03
Fancy II.,	537.9	15.4	74.93	27.33	31.89
Betty II.,	827.2	23.6	115.89	39.54	46.13
Cecile,	793.5	22.7	113.39	39.91	46.56
Red III.,	810.5	23.2	113.31	44.33	51.72
Totals for herd,	7,278.4	20.81[1]	1,074.38	407.67	475.63

[1] Average daily yield.

Total Yield of Milk Products (Pounds) — Concluded.

Cocoanut Meal Ration.

	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent (Fat+1/6).
Samantha,	698.8	20.0	110.62	47.10	54.95
Amy,	482.8	13.8	73.63	31.29	36.51
Gladys,	579.6	16.6	86.59	35.76	41.72
May Rio,	592.3	17.0	91.63	38.14	44.50
Betty,	720.3	20.6	103.72	38.68	45.13
Ida,	525.3	15.0	90.40	40.97	47.80
Fancy II.,	583.5	16.7	82.86	32.56	37.99
Betty II.,	1,124.8	32.1	155.00	56.46	65.87
Cecile,	991.5	28.3	145.65	56.22	65.59
Red III.,	902.3	25.8	129.48	54.68	63.79
Totals for herd,	7,201.2	20.6[1]	1,069.58	431.86	503.85

The 10 cows produced substantially the same amounts of milk and milk solids on both rations. In the case of the total milk fat the difference is somewhat in favor of the cocoanut meal ration (nearly 6 per cent.). This may have been due to the influence of the oil in the cocoanut meal.

Adverse Influences.

1. The attack of scours between halves.

2. The feeding of a new lot of hay during the last two weeks of the trial. The hay, however, was fed to each of the 10 cows so that all were treated alike.

3. While like amounts of gluten feed and cocoanut meal were fed to each herd the cocoanut meal contained 6.49 per cent. of moisture, while the gluten feed contained 10.28 per cent. During the entire experiment, therefore, the cows received 50.2 pounds more dry matter (.14 pound daily) in the form of cocoanut meal than in the form of gluten feed.

Inasmuch, however, as the cows ate rather less hay while receiving the cocoanut meal, and as the total digestible nutri-

[1] Average daily yield.

ents fed were slightly in favor of the gluten feed ration, it is probable that the small excess of cocoanut meal was without influence on the results.

General Conclusions.

1. Cocoanut meal is of the same general type of composition as gluten feed. It contains more fat, ash and fiber and noticeably less carbohydrate matter.

2. Cocoanut meal was found to contain about 100 pounds less digestible matter in a ton than the gluten feed. By converting the fat of the cocoanut meal into its starch equivalent, however, its nutritive value would be rather above the gluten feed. One hundred pounds of cocoanut meal contained 88.4 therms of net available energy as against 82.7 therms for the gluten feed. This is clearly due to the higher percentage of fat in the former.

3. Our feeding experiment with 10 cows shows substantially the same results in the amount of milk from the cocoanut meal and gluten feed ration; slightly more butter fat was secured on the former ration.

It is believed that the cocoanut meal is fully equal to the gluten feed in nutritive value, although it is doubtful if it exceeds it. German observers consider it particularly desirable for dairy animals in amounts of from 3 to 4 pounds daily per head, and it has been shown to somewhat increase the fat content of the milk. Fed in excess of the above it is held to make too hard a butter.